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ABSTRACT

The 32nd annual American Industrial Arts Association (AIAA) Convention was held in Louisville in 1970. Topics for the AIAA general session addresses were: (1) "Industrial Arts--The Blender Between Social Form and Technical Function," (2) "Technology and Society: Present and Future Challenges," (3) "A Student-Oriented Industrial Arts," (4) "Man: End or Means," and (5) "Extensions of Technology: From Utopia to Reality." There were also 31 general session addresses for the American Council of Elementary and Secondary Industrial Arts, the American Council of Industrial Arts Supervisors, and the American Council of Industrial Arts Teacher Education. Representative addresses from the major and special interest sessions included 146 presentations in the areas of Instructional Systems, Technology, Classroom Teachers, Metals and Materials, Computer Assisted Instruction, Curriculum Development, Electricity/Electronics, the Federal Government, Teacher Education, Students, Correctional Institutions, Evaluation, Woods, Special Education, Business, Guidance, Safety, Drafting, Graphic Arts, Media, Plastics, Research, Communications, For the Disadvantaged, Power, and Space Technology. (GEB)

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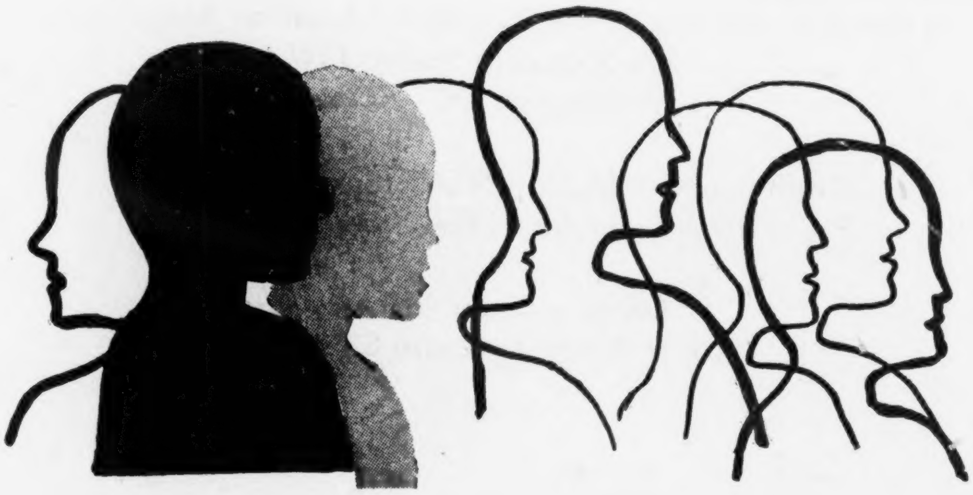

representative addresses and proceedings of the american industrial arts association's 32nd annual convention at louisville

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aiaa general session addresses

Industrial arts—the blender between social form and technical function

Robert D. Gates

It appears to me that during the moments that we have either survived, lived through, managed, or ordinantly developed something in terms of change during the last year, most of us have had second thoughts, not just about our profession, not just about the words industrial arts, not just about words like technocracy and technology, automation and this type of thing, but about how we feel as people - what it is that we do as young men and women and boys and girls and how we effectively mold human clay.

As I thought about this presentation, I saw the industrial arts personality or image as made up of people of many disciplines, with many skills, coming from many periods of the immediate maturational time that has made us the nation and the part of the world that we are. And as I have thought about these I wondered, "How do you feel?" How do you feel, not just about coming to your great convocation, not just about the maturity of your organization, not just about the honors that you award. And I received one of those honors a year ago, and I think that to my colleagues from Buffalo and to the people who distinguished me by allowing me to join that particular great group, came something special and different in terms of what kinds of people are we who mold human clay.

How do we blend social form with technical function? Perhaps no other group has more control of what will happen than the group sitting here this evening. Very frequently I make the remark to groups that you're on the "cutting edge". I don't really think that this is the way that I would personally address people in the industrial arts field. To the contrary, I would feel that people in this field of endeavor are at "the balance of the fulcrum". Which way are you going to shift your weight during the twelve months that lie ahead? How will you reach out with your know-how toward your educational colleagues, the communities in which you live, the industrialists with which you deal and the young people with whom you learn about tomorrow?

We have two grandchildren now, and with the image of being a grandfather, something happened to Bob Gates, because up until then, I thought of myself as a young man. I think that, in effect, I suddenly realized that not only was I potentially a part of the establishment, but I was also potentially a person who didn't really care what somebody else thought any more. I knew I had been the route - I had been there. In essence, I think that what I'm suggesting is that each of us does have a philosophy, a feeling of self, an awareness in this time of the change that is happening in the social mix that is our society.

What is that social mix? How is it made up? How do people handle it in what we call urban centers, and how do they handle it in what we call suburbia, and how do they handle it in less suburban areas that we still on occasion refer to as rural? How do you feel about your community? Are you philosophically an essentialist? Many people in the industrial arts field are. Are you a classicist? Very few people in the industrial arts field philosophically are classicists. Are you a perennialist? Are you a humanist? I suspect that more counseling actually occurs across the bandsaw after the blade is broken than most of us willingly understand or admit to, except when we're talking to our educational colleagues that don't understand about wanting blocks of time bigger than a period to work with. I think that way when we try to express what it is that happens in the advancing development, the utilization, the change which is occurring.

What really is occurring in our society? For several years it was my good fortune to be responsible for about 8500 people in thirty-three countries around the world. They were training underdeveloped nations. They were training people and individuals who were less fortunate than most of the people with whom we work daily. And from this experience came a most unusual kind of feeling and attitude on my part. And I share it with you this evening in a sentence: "Technology is more effectively used in the underdeveloped nations of the world than it is here where it is produced for utilization." Even those of us who are closest, you and me, in this field of educational endeavor, are making poorer utilization than I suspect you would find in almost any underdeveloped nation of the world, where there is but one thing different: They have the technology because of various kinds of program aids which we send there, but also, they say, "We're so far behind we'll do anything to catch up".

Have you thought perhaps that your curriculum could have gotten behind? Regardless of whether you are any of those philosophically, whether you're a pragmatist or whether you're a complete modern in terms of some of the philosophical fields of thought which might make you a reconstructionist (as I understand the word) - regardless of these, I would suggest there are five basic elements that are involved in molding human clay and do determine social form. The first is: "The worth and dignity of the human being." What is there about you that brings this to the front in terms of the way you behave toward yourself and toward others?

Secondly, there is "Respect for self". Do most of you - academically, educationally, industrially and technically — respect yourselves? Not just do you change the curriculum, but do you respect yourselves as molders of human clay? Are you people who basically and fundamentally can respect others because you respect yourselves - because these are interactive molds? These are things which do require, basically and fundamentally, that first you respect yourself and secondly that you use this respect in respecting others.

The fourth item of all those philosophies, as I see them, and the thing which basically creates social form, is what I call equality. The great documents that made us a nation are just documents without politics. I think sometimes we as educators are fearful, extremely fearful, that basically and fundamentally we will become ensnarled in what we refer to as politics. I would challenge each of you to look at social form. To look at the closeness of tomorrow's vote for Justice of the Supreme Court. To determine that fundamentally if the Vice-president breaks the tie, this can still be a great moment in history, regardless of which way he votes. That fundamentally decisions are made by opinions being expressed and being reviewed. But to me equality is a trinity of ideas: Equal worth in the sight of God, equal rights before the law and equal opportunity to develop one's own innate potential.

The fifth idea which I think I find in all philosophies which molds social form within reason I do not have as well documented as I feel I have those first four points. But it is the cohesiveness of love and not the cohesiveness of force which brings about a lasting change in human behavior. What is, then, the social form of your community, your curriculum and the feeling of self that you have about the people with whom you live daily?

If we are to deal effectively with our society, we must recognize some of its rather limited dimensions in terms of the moment. Shortly another group of men will make hopefully as equally as successful a trip to the first satellite in that perimeter around our earth that we call moon. Technologically this is a feat of some substance. Basically how do you merge these when you talk with youth and build curriculum? How do you really deal with technological function? What is our world like in some of its dimensions? The youngster who is youngest at the moment at the Gates' household is 12. When he is at half life, he will be 45 years of age, because life expectancy for him having survived these twelve years in the better-developed areas of our country that he did gave him a life expectancy of 90 years. At half life he will be 45. He will be alive in the year 2000. He will be confronted at that time not just by the ecological developments that will take place between now and then, but he will, in all probability, be confronted with fourteen times the total human knowledge that we have tonight. And also he will be confronted with three times as many human beings living on this sphere we call earth.

I think that we can rationalize that some of the kinds of things that are important about the next few years are just "something that's gonna happen after I leave the system". And that's not true. What's "gonna happen" has already happened.

I recently finished some interesting work in the area of the management of solid hospital wastes. As you think of various forms of ecological problems, I'm sure you recognize that waste is a part of this problem. Now hospital waste has an emotional override that goes with it, but how many of you know that in the hospitals of your community during the last 18 months, the per pound per patient per day weight of discharged waste has gone from 3 pounds to 16 pounds? And how many of you realize that in that period of the next 18 months we expect it to go to 32 pounds? And that we will be planning for the removal every five days of the average body weight of the person in the hospital?

Social form and technical function. How will we deal with this? How will we as the molders of human clay make the changes which are necessary?

I'd like to suggest to you this evening that we will use nine conditions which are essential to learning. Most of you are aware of these in one or more forms and have probably seen them in the literature for a number of years. These were actually derived by Ralph Tyron and a number of other people in the behavioral science centers around the world, who took those instruments and instrumentalities we refer to as computers and reduced human knowledge - reducing it in such a way that you as an industrial arts administrator, supervisor, teacher, person on the line, part-time teacher, part-time learner, whatever be your given clime at the moment, basically and fundamentally can reach back into human knowledge and find whether or not these conditions are in fact supportable by you.

What is it that we're really saying in these nine conditions? We're saying that this is the blend between social form and technical function. As I mention each of these, you as industrial arts personnel regardless of the moment of your instruction and the moment of your molding of human clay, will in fact find a new determination to bring about within the educational community that balance of the fulcrum which is so desperately needed because not only are you on the cutting edge, but you are also in that delicate moment of balance when, as many of you recognize, technologically we have been since 1956 in the sense of transfer of white- and blue-collar worker load in our work force, to the moment just ahead of 1956 when for the first time civilized man could reverse history.

I was in the escort at Nagasaki when the second bomb went down. I've been back to Hiroshima to do research with some of the people that were in the LD50 rain – Lethal Dose 50 – one in every two people died within that rain. I've been working with some of the youngsters that are more than their parents (both within the LD50 rain) to look for abnormalities greater than chance that they anticipate because of radiation. Because the experiments now in the 43,000th generation of the studies that we made following that blast still are showing incidents of mutations higher than chance. Now what are we really saying? What are we really saying? We're saying that we can reverse history because of technology. The cloud at Nagasaki was 40,000 feet high. The cloud 18 months later was 40 miles high. And we now have an instrumentality of destruction which is so much more powerful than that second cloud that I sincerely hope that each of us considers in a profound way the necessity to continue talking at the conference table, rather than allow an active confrontation between those forms of detonation which bring with them that kind of power. What are these conditions that build this blend that help you balance?

The first one is motivation. It's interesting some of the research that we find in the area of motivation. The word "Daddy-o" came out of the fact that many of the people living in suburbia basically saw the male image not very much and not enough. And so a lot of young people suddenly were confronted with the fact that the best male image they had in suburbia was an older adolescent, and we developed a word called "Daddy-o", in terms of lingo roughly a decade ago. Today we have some violent four-letter words that people are pretty disturbed and upset about. Most of us say them as dirty words. Most of us find people who use them either to proliferate dirt or in some way to force us into a less desirable posture as human beings. But I would suggest for your consideration that moments are ahead when we had better understand what the motivation is when a youngster uses a four-letter word.

The second condition which we must understand if we are to learn, if we are to blend and if we are to balance, is that we have to accept that current behavior is inadequate if we're going to learn. When you go into a given area and you are watching a teacher perform and you know and the teacher doesn't know, you're in a dangerous position. The thing you must learn is, how does this teacher learn? How does it happen that this new person, this molder of human clay, out of industry perhaps, this person we needed desperately to round out our program, to bring a whole new form of technology, to survive with us in this moment of truth? How is it that this person, this individual, needs me?

How many of you feel inadequate when you watch a computer operate? Does it help you learn or do you behave like the rest of the society? I've made an offer from many platforms for a long time, that I'll pay $100.00 to the first person who brings me, from a regular publication of any kind, a cartoon that's positive about a computer. The thing that I would point out to you, however, is that in all this negativism that we've been able to muster in a sardonic and sarcastic way about these, they've come on awfully well.

I think it's also interesting to note that basically we have today great corporations that are building these devices. But there are some, depending on whose figures you use, 42,000 to 70,000 active computers in the United States today. There will be before the end of this calendar year available for basic use from three different corporations, devices any six of which will do all the work of the 42,000.

Is it possible that we need to look more pointedly at our inadequacies? How do you really feel about machines? Because, you see, how you feel about them as industrial arts personnel may have a greater effect on the total change of the educational community than any other person on the staff. But how do you feel about machines? I'm not talking about the type you mustered and mastered when you were nine years old and had your first power tool. That's not what I'm talking about. I'm talking about how you feel about machines. How do you talk to the staff of the English department? How do you talk to the social studies department? How do you talk about ecology in terms of machines? What you say as the industrial arts leader may be more effective in what we do in blending social form and technical function in the next year than any other group of educators in our land.

The third condition is that there has to be guidance of the desired activity. There has to be a teacher. Can a machine teach better than a human teacher? Yes. Most of my colleagues off rostrums, after they say that kind of thing, immediately go into a long list of qualifications about what they didn't mean to say. I meant to say exactly what I said. In essence, as in dealing with the intellectually disabled youngsters which many of you find in many classes of industrial arts and various forms of vocational education because they can't handle academic work successfully, if successful training of these youngsters is a part of teaching, then basically the machine can do it better than a human. I watched a youngster the other day ask the same question over 400 times without stopping. There are no human teachers who can answer the same question 400 times without stopping. As a matter of fact, by the time you have answered the same question the third time, most of you are irritated with the youngster. "I told you Friday, I told you again yesterday. Can't you remember?" Suppose the youngster wanted to ask the same question 400 times? Suppose the training of this youngster required the fact that this was the way he dealt with his nerve tissue?

The fourth condition essential to learning is new materials that demand new learning. How many of you have introduced, either by interlocutory relationships with some of the industrial giants that are in your exhibit area or by your own devices, new materials that demand new learning during the last twelve months? How many of you as industrial arts people are openly looking for a blend between social form and technical function? Not just in the equipment that you purchased, not just in the workbooks that go with it, but in reality between the knowledge that we have technologically and the social form that you want to maintain in our society.

The fifth condition essential to learning is time. There is no research that supports thirty children in a classroom, five days a week of school, forty, forty-five, fifty, fifty-five, sixty, or any other number of minutes in any sequence as a good way to learn anything. Two exceptions: (1) In the Old Testament, I believe it is in Isaiah, it says, "'neath the shade of a tree may sit thirty and there learn well." And in the Koran, Book of Mohammed, in Unit 16 it says roughly the same thing. In these we find the only two references to thirty children in the classroom. But we have built the whole public and private school system around ideas like this. Why? Because of convenience? Yes. Because of administrators? Yes. Because of the belief we have that everyone ought to learn something about some things? Yes.

The blend between social form and technical function must now be served going both ways. You who stand at the fulcrum, you who balance that delicate point, must recognize that there are over 600 schools in the United States today that don't take in youngsters five days a week any more. I mean secondary schools. One in the northeast took in students only three days a week last year in grades ten, eleven and twelve (in the quartiles we call four). They had more merit scholars that year than they had in the history of that school system. Teachers had time to teach and students had time to learn.

How do you plan to do this without technology? How do you plan to do it without orienting the community? How do you plan to do it? You've known about doing it since you took Education 101, whether you enjoyed it or didn't enjoy it, in the college of education. Twenty-five years ago that research hit the deck. You stand at the fulcrum. Time is one of the dimensions we don't have any of.

Six percent of the world's population lives in these United States. That six percent of the world's population has one-half of the world's wealth, controls twelve times the oil reserve and fractionalization thereof of the rest of the world, and fifty times the electronic potential of the rest of the world combined. You have a responsibility to the ninety-four percent of the population that lives in the rest of the world. You stand at the balance – not just at home, not just in the classroom, not just with your staffs. You stand at the moment of balance between whether man will survive free or slave, because a third of the world is free, and a third is slave, and a third is trying to make up its mind which it's going to be.

How many of you speak Japanese, Chinese, Arabic, Hindustani or Hindi, Portuguese or Russian? Nine hundred million of the one billion people in the one-third of the world trying to decide whether they should be free or slave tonight speak those languages. How do you plan to communicate with them without technology? How do you plan to have youth go out from your programs without a technical base for communication?

The sixth condition essential to learning is satisfaction. You probably have one of the greatest devices available to any person - the product of building or making something within the realm of your control within your curriculum.

How do you really feel about work? Thibold in Cybernetics is correct in the fact that today, with two percent of the populations and no technological advancement of any kind to do all the work we are now doing, ninety-eight percent of the population can sit on its hands. Have you taken a hard look at your curriculum in terms of four kinds of wealth-producing activities in terms of the kinds of things that do, in fact, happen in your curriculum (which must be communicated effectively to the rest of the educational community)?

How many of you can remember the poem you learned in the fourtn grade? If you can, you learned it. If you can't, you memorized it to satisfy somebody else. I suggest only to you that you take a hard look at the new informations and knowledges about learning in terms of memorization. You will find yourselves midway into those "lookings" at that new knowledge - looking at those metabolic studies in terms of whether learning is chemical. And if learning is chemical then you must apply some of the techniques that you now know to what it means in terms of the aerosol effect around you, is or is not polluting with sulphurs or metabolic change in terms of what kind of learning will go on at any one point in your community on a given day. You stand at the fulcrum. You have in your hands the balance of social form and technical function.

The seventh condition essential to learning, most of the literature calls sequential practice and differentiated reinforcement. That is educational jargon for skill and drill. How much skill and drill is there in your curriculum? Remember only one thing, you will find that there is no learning that takes place from skill and drill unless each trial is harder and more demanding than the previous trial.

Remember all those workbooks full of numbers in fourth- and fifth-grade arithmetic? Have you thought of talking to the mathematics section about revising those pages so that youngsters who had to go through them anyway apparently in their curriculum would in fact learn? Even more important, have you thought about sanding and squaring and all kinds of things we do in various aspects of woodworking? Have you thought of circuitry and direction of flow and some of these kinds of things that are products of various aspects of the curriculum of industrial arts and various curricula? Have you really thought through what is harder and more difficult each time in terms of producing a real learning? It is like interscholastics, in a way. When the coach has the boy go down and fake in and drive out, go down, fake in and go out, go down, fake in and drive out, unless each trial is harder and more demanding on the part of that youngster, there is no learning. And if there is no learning, we do have to question its role in the educational package. But if there is learning, then we have a whole new way to look at interscholastics. We have to think about it in order to do it and bring about the balance which is required.

The eighth condition essential to learning is, high but obtainable standards. Most of you say you get a lot of youngsters you don't want because people dump them there. Is that really true, or are you the place where those youngsters can best meet the requirements for tomorrow? Do you live at the moment of history in your particular arts programs where youngsters who would fail would survive more effectively because of what you're doing? Or does your gripe go on and on? Does this great organization have a posture and a standard and a feeling on how it really stands on this point? Yes, it does. And do you know what it is? I charge you as professional members to find out. I challenge you and your officers - past, present and future - to drive into being something that will make this organization great in the time immediately ahead in regard to balance.

For what it is worth, I would like to put in a few extra things about this. I would like to use an example of putting a barricade in that doorway and making it about four and one-half feet high, then say that each of you must jump over it before you can go back to the receptionist in the hotel. Some of you would be here longer than others. Remember, we have built a system by putting up a standard and saying, "Jump, jump, jump!" Very bright kids say, "Can't jump." So we create classes for non-jumpers. And we talk about ghetto schools. I taught in the Stuyvesant School in New York. A youngster got there by having "incorrigible" written across his folder. I walked into a classroom that had had nine teachers in six days. Somebody in about the third seat in the second row said, "Why you . . . . ." and let out a lot of four-letter words. "What do you think you're going to do?" And by the time he had gotten all the way up, I had hit him. And he went down, fortunately, and I said, "Who's next?" I don't believe in capital punishment. I just believe in getting the attention of the learner.

When did we as a society get so soft? I'm not talking about hitting kids. I'm talking about saying that's a good job and that's lousy without feeling we are going to set up some chain reaction of mental instability. I didn't say, "You're a good boy and a bad girl"; that will do it.

Why don't we as part of our balance talk about the kind of job that is done? And what will we find? Fewer mental health problems, because we will become more consistent. It is almost that easy. We know how to do it. There are things we know how to do we can't do. It is like the mother who brings her two-year-old into the clinic. The youngster is a feeding problem and you say, "I can solve the problem." And she says, "Oh, would you please?" And you say, "Well, I'll tell you, but you can't do it," and she says, "I'll do it!" You say, "Put food in front of the child for 20 minutes, three times a day, take it away with no comment regardless of whether he spills it, eats it, or what he does. In two weeks you won't have a feeding problem." The interesting thing is that clinically this is true. There isn't one mother in a thousand who can do it. The cost of food alone keeps most of them from doing it, but, in effect, what we don't need is a lot of self-styled experts telling us how to run our business. What we do need is to get back at our business instead of telling a lot of others how to run everybody else's. You stand at the fulcrum.

The ninth condition essential to learning is, it is the evaluatee and not the evaluator who is important in testing. The evaluatee has to participate in the evaluation if there is to be learning. How do you test youngsters? How do you really move people into marks? How do you handle the grading of teachers? What is a merit raise in your system? How many of you like to take tests? How many of you are disgusted when you look at academic life, highly-acculturated standardized testing that isn't going to measure the youngsters in your group? What are you going to do about it? Have you just been angry with your academic colleagues in other parts of the curriculum? Or have you said, "Basically, the evaluatee has to participate in the evaluation or there is no learning." That means that all testing in which youngsters who are taking the test do not participate actively is just time consumed for something. Have you seriously considered the fact that we could change the timetable? That we could even gain on our need for time?

Of these many philosophies that we mentioned in terms of their many elements, I'm sure we are together about these five overall basic ideas. I suspect we have very different basic reasons for being the way we are and for the way we answer people about philosophy. I would say that most industrial arts people are not given the opportunity to talk about the philosophy about the field or the philosophy of learning that they have as it relates to the field. I challenge you to do a great deal more of this immediately with your educational colleagues.

I would suggest you get your curriculum from your students. I would propose that you use your universities and colleges as a place to try on those students who are betwixt and between. They are no longer in the high school and they are not yet in the fold as mature teachers as part of the guard that will help you determine where you stand as a great association.

In closing, let me, if I may, see if I can express some of these same ideas in another way. I like to write what I call verse. (I used to think that I write poetry; then I got around some very bright people who write poetry, and I realize that what I write is verse.) It goes like this:

I met a boy or girl a day or two ago
  who I'd heard about and mostly bad from so and so.

But when I met them what I heard began to fade
  because in me a very personal friend they've made.

We walked a bit and talked a bit and finally just us three
  settled down to thinking as we sat down by the sea.

And in their conversation then to me their hearts lay bare
  and friendship was the thing for which they had a flare.

I think we're going to be okay, that boy and girl and me,
  because the hardest part is over and we trust each other, you see.

Do you trust each other?

There are three questions you have to answer to bring balance on that fulcrum between social form and technical function. They are, in some form, "What do you mean?" "How do you know?" and "What is it worth?"

Try these three questions on for size with any youngster who is getting away from you and see what happens. When you are just about to hit them, ask them, "What do you mean?" "How do you know?" and "What is it worth?" I suspect not only will you not hit them in a physical sense, but you will pulverize them intellectually.

Have any of you been really surprised that some of the boys from Vietnam came back to see you? You might be interested to note that it was likely a boy you "never touched". It wasn't just that he was quiet, because he got into as much trouble as the rest of the students; it was that you "just never got to him". You never had time to get to him. The fascinating thing about this is that, in not having time to get to him, you were consistent in your behavior toward him. In being consistent in your behavior toward him, you came off being his favorite teacher. A fascinating idea!

Some friends of mine the other day felt compelled they
had to confess the world was in an awful mess.

And as I was about to add my part to this discussion sad,
I stopped to look where I stood and wondered if I really should.

I wondered through this chatter if there was anything that
I could add that would really matter.

If there was anything I could say that would give us light
just one more day.

Then I guess I realized how this talk had materialized
we didn't know, we were scared. So to our friends
our hearts we bared and we sought security for yours
and mine and me.

What was this thing that I sought for you and you
for me, this wonderful thing – security.

The group broke up with a sigh because its troubles
would not fly.

And then I knew, for what it's worth, I'll pass it on to you.

Ask my God for me to pray, that I might in every way,
in every word and action bring about just a little
more of satisfaction.

And we who are intelligent should say a prayer of thanks
and never belittle those who fill the less-developed ranks.

For there is no glory in the wisdom we mass
except as we imply it for the good for every class.

The little men of gilt who hold their noses high
are not the ones whose luster stars will linger in the sky.

They are the vain and the selfish and blind that cannot see
that they are gifted only by God's generosity.

But those who share their wisdom and their lore
possess the preeminence which will endure forevermore.

I trust you explicitly as you balance the fulcrum between social form and technical function.

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Technology and society: present and future challenges

Steve M. Slaby

The problems of technology, in reality, are human problems, since it is man who has created technology and it is man who uses this technology for ill and for good.

Scientists, engineers and educators, as well as individual inventors, technicians and craftsmen, have made critical contributions to the creation and development of modern technology. At the same time their contributions to this technology were not created in a vacuum – this technology has been promoted, supported and financed largely by non-engineers and as part of the social, political, economic and business processes of our nation and of our world. So if we have air and water pollution as serious problems today, we are all to blame. If we have indiscriminate and poorly-planned urbanization of the countryside which destroys nature – we are all to blame. If we have social and racial injustice and turmoil and decay in our cities, we are all responsible for this state of affairs. What I am trying to stress here is that the engineers, the technologists and the professionals in the industrial arts areas, with their technical-scientific backgrounds, understand the technical aspects of technology, but in most ways seem to have neglected to consider the social and human consequences of their creations. The liberal arts people and the average citizen – whom we can classify as non-engineers and largely not technically knowledgeable – have on their part neglected to learn to understand the methods of technology and the impact of their applications on individuals and society. From this we can see that the mutual responsibility for our present condition is obvious.

The concept of technology is a dichotomy in that, on the one hand, technology has been a great boon, in many ways, to the human race, but, on the other hand, this boon has been developed at a very high cost to human beings and their environment.

There are basically two main viewpoints expressed on technology. One is optimistic, where technology and more technology are considered to be the answer to the human plight on this earth. The other approach is pessimistic and is critical of nearly all aspects of technology and blames the technologists for most of the problems confronting the world today. In my presentation I will examine both viewpoints and in the process attempt to develop a more acute awareness of what is really involved when we speak of technology and society and when we individually consider its present and future challenges.

I have been using the word "technology" freely and up to now have not attempted to define it. Normally when we use the word technology we tend to relate and limit it to a connotation which involves only engineers, mechanics, factories, machinery, hardware, engineering and industrial arts schools, computer centers, space exploration, civilian and military goods and equipment, etc. However, a broader definition of "technology" is possible and necessary if we are to comprehend fully its impact on mankind.

Robert Merton, in his foreword to the book The Technological Society, by Jacques Ellul, shows how Ellul relates technology to technique in general, and, in doing this, broadens the concept of technology to an all-inclusive one where technique is defined as "any complex of standardized means for obtaining a pre-determined result. Thus, technology so defined converts spontaneous and un-reflective behavior into behavior that is deliberate and rationalized." (The Technological Society, Jacques Ellul, Alfred H. Knopf, New York, 1964, Foreword, page VI.)

What is the effect of technology so defined? Ellul observes that "the irreversible rule of technique is extended to all domains of life". This results in a "civilization committed to the quest for continually improved means to carelessly examined ends.... Technique transforms ends into means. What was once prized on its own right now becomes worthwhile only if it helps to achieve something else. And, conversely, technique turns means into ends. Know-how takes on an ultimate value". (op. cit.)

In examining the political effects of technology in this broad sense, Ellul agrees with Robert Hutchins (of the Center for the Study of Democratic Institutions in Santa Barbara, California), in that "politics ... becomes an arena for contentions among rival techniques ... to the technician the nation is nothing more than another sphere in which to apply the instruments he has developed. To him, the state is not the expression of the will of the people ... it is an enterprise providing services that must be made to function efficiently." ("Doing What Comes Scientifically", Robert M. Hutchins, the Center for the Study of

Democratic Institutions, Santa Barbara, California, p. 6).

In a study entitled "Program on Technology and Society", conducted under the auspices of Harvard University, a paradox appeared: Technology, according to this study, on the one hand has in this country "created a society of such complex diversity and richness (where) most Americans today have a greater range of choice, wider experience and a more highly-developed sense of self-worth than any other people have ever had." On the other hand the same technology, according to this study, "poses a threat to that society if that society is contented to merely enjoy the fruits of technology without attempting to answer it and through understanding control it."

The Harvard study warned that the greatest threat of technology was a political threat, since our society may become so completely dependent on technology and upon "technologists" who administer it that the very nature of the society may change. The implication here is that the change would not necessarily result in a better society, since the individual citizen would have even less impact in this new society on the decisions which result in the introduction of new technology which can profoundly affect his life and his environment.

The Harvard study stressed that the average citizen and elected representatives must learn more and know more to be able to ask the right questions if technology is not to infringe further upon the role the individual should play in having an effect on those who govern him.

This sentiment is supported by Vice-Admiral H. G. Rickover, who, in a speech delivered to a symposium dealing with "Automation and Society", sponsored by the University of Georgia in 1969, said: "Every citizen is duty bound to make an effort to understand how technology operates and what are its possibilities and limitations...."

"A free society centers on man. It gives paramount consideration to human rights, interests and needs. But once ordinary citizens come to feel that public issues are beyond their comprehension, a pattern of life may develop where technology, not man, would become central to the purpose of society. If we permit this to happen, the human liberties for which mankind has fought, at so great a cost of effort and sacrifice, will be extinguished." (The Wall Street Journal, March 10, 1969)

Victor C. Ferkiss, in his book Technological Man: The Myth and the Reality (George Brazilla, New York, 1969), challenges the critics of industrial society when they imply that "man is a cog in the machine, or a product produced by it, or both." Ferkiss points out that if this type of criticism is accepted, the alternatives are "revolt, withdrawal, or despair".

He holds that because of the continuing development of technology, the argument as to whether or not industrialism has created a mass society threatening human freedom "has been rendered meaningless." It is his contention "that the industrial era is already in the process of being superseded by a new phase in human history and that industrial man, whatever his characteristics, is evolving into something different and superior – technological man." And according to Ferkiss this will lead to human liberation rather than destruction. (op. cit., page 271)

A less optimistic thesis was presented by Ralph Nader in an article entitled "The Engineer's Professional Role", which appeared in the February, 1967, issue of the Journal of Engineering Education of the American Society for Engineering Education. In this article he wrote that "insofar as technology does things to us that we do not want to endure, to that extent can it be called out of control. As long as there is undue and parochial attention paid to the short-range economic utility of product and process, at the same time that the short- and long-range biological consequences are treated with indifference or contempt, our society is going to plunge into deeper collective cruelties."

"What is now out of control," Nader feels, "may soon be running amok in an arena of macabre anarchy so immeshed in giant bureaucratic structures whirling in furious activities over means, that the accountability for the ends of human welfare are blurring more and more. And with the jet-paced growth of new technologies, full of potential for both ease and unease, the lag between a framework of responsibility for the safety of the man-made environment and the increasingly far-reaching impact of corporate decision-makers threatens to render the future significantly more challenging to our humane values than the past." (Journal of Engineering Education: Feb. 1967, p. 450)

In his essay "Objectivity and Liberal Scholarship", Noam Chomsky, professor of linguistics at MIT, states that "the Western sociologist sees in the rise of intellectuals to effective power the hope for a more humane and smoothly functioning society, in which problems can be solved by 'peacemeal technology'..." He continues by saying that "there are dangerous tendencies in the ideology of the welfare state intelligentsia who claim to possess the technique and understanding required to manage our post-industrial society and to organize an international society dominated by American superpower.... Insofar as the technique of management and control exists, it can be used to consolidate the authority of those who exercise it and to diminish spontaneous and free experimentation with new social forms, as it can limit the possibilities for reconstruction of society in the interest of those who are now, to a greater or lesser extent, dispossessed. Where the techniques fail, they will be supplanted by all of the methods of coercion that modern technology provides, to preserve order and stability." (American Power and the New Mandarins, Pantheon Books, New York, 1967, 1969, p. 125).

Chomsky in his essay also comments on intellectuals and the schools, and he contends that "as American technology is running amok in Southeast Asia, a discussion of American schools can hardly avoid noting the fact that these schools are the first training ground for the troops that will enforce the muted, unending terror of the status quo in the coming years of a projected American century; for the technicians who will be developing the means for extension of American power; for the intellectuals who can be counted on, in significant measure, to provide the ideological justification for this particular form of barbarism and to decry the irresponsibility and lack of sophistication of those who will find all of this intolerable and revolting." (op cit., p. 310)

Chomsky further challenges and questions the goals and quality of our educational system and the intellectuals who comprise it. He points out the traditional role of intellectuals has been as "dispassionate critics", and he decries the "comparative indifference of American intellectuals to the immediate actions of their government and its long-range policy, and their frequent willingness – often eagerness – to play a role in implementing these policies." (p. 314). He observes that what we must expect "is that political elites will use the terminology of the social behavioral sciences to protect their actions from critical analysis...." (p. 317).

In his essay "One-Dimensional Man", Herbert Marcuse, professor of philosophy at the University of California, states that "... with the growth in the technological conquest of nature grows the conquest of man by man. And this conquest reduces the freedom which is a necessary a priori of liberation. This is freedom of thought in the only sense in which thought can be free in the administered world – as a consciousness of its repressive productivity, and as the absolute need for breaking out of this whole." ("One-Dimensional Man", Herbert Marcuse, Beacon Press, Boston, 1968, p. 253.)

In discussing freedom, Marcuse remarks that "... society must first create the material prerequisites of freedom for all its members before it can be a free society: it must first create the wealth before being able to distribute it according to the freely developing needs of the individual; it must first enable its slaves to learn and see and think before they can know what is going on and what they themselves can do to change it. And, to the degree to which the slaves have been preconditioned to exist as slaves and be content in that role, their liberation necessarily appears to come from without and from above. They must be ... forced to be free ... to 'see objects as they are, and sometimes as they ought to appear, they must be shown the ... good road ... they are in search of'." (op cit., p. 40).

Marcuse reacts to this position by stating that "but with all its truth, the argument cannot answer the time-honored question: Who educates the educators, and where is the proof that they are in possession of 'the good'?" (op. cit., p. 40).

In an address to the 23rd session of the General Assembly of the United Nations, Ambassador Astrom of Sweden made the following statement: "Man is today in possession of scientific and technological resources which are truly spectacular. It can safely be assumed that further progress will follow in the years ahead. The achievements of science and technology are the prerequisites of rapid economic development, just as they form the material basis for the armaments race. So man has now in his hands unprecedented possibilities for destroying himself but also for bettering his lot on earth. Let me say in passing that if only a fraction of those resources in the form of brain power, technical know-how, equipment and capital which are now devoted to the perfection of the means of mass destruction were released to be utilized for social purposes, for the rational planning of the human environment in urban and rural areas, then the total gain in terms of human happiness and of social justice would be enormous." (23rd Session, General Assembly, provisional verbatim record of the 1732nd meeting, New York, Dec. 3, 1968, p. 16.)

The range of opinions on technology and its effect on man and society varies, as you can see. The debates, arguments and discussions range from almost utopian predictions of the contributions that science and technology will make to man's living of life, to depressing negative prognostications.

As educators we have a unique opportunity to explore in depth, with our students and peers, the role and impact of technology on human life today and in the immediate future. I hope that each one of us will seriously reflect on the character and meaning of this force called technology. As educators in technological areas, we have a major responsibility to teach our students not only the techniques of technology but also to make them aware of the creative and critical role they can and must play as knowledgeable citizens in continually developing and maintaining a society which serves the interests of all the people. This means that technology must serve man – and not the contrary.

The present challenges do not only include problems of environmental pollution and disruption of the ecological balance of nature, but most importantly the problems of human relations, which are an integral part of total ecology. The present challenges are intimately interwoven and connected with the future challenges facing mankind.

How we handle – or don't handle – our problems today will set the pattern for the future. Whether liberation of man from ignorance, hate, impersonality and war will result, or whether an epoch of human repression is man's future – a repression which will condition him to accept brutality with feeling – a repression which will result in man living life with the least sensation of consciousness – is being determined by us in this age, in this place.

In the final analysis, it is man himself who is the greatest present and future challenge.

The present and future challenges are in our hands – the gauntlet has been thrown to us. What we do now as educators and citizens will determine whether these challenges can be confronted and dealt with in a humane manner, where the individual person will be able to maintain and preserve his dignity and freedom.

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A student-oriented industrial arts

G. Don Townsend

The topic given me from which this talk is being presented is "A Student-Oriented Industrial Arts". After doing some research to find out just what this topic meant, I have the following to report:

According to Webster, orientation may be defined as "the familiarization with and adaptation to a situation or environment; specifically, in psychology, interpretation of the environment as to time, space, purpose and persons."

I am a senior in Crane High School in Crane, Texas, and very little could be done in the direction of orienting the courses of industrial arts for me; but for those who will come after me, I can see a whole new field opening. By letting the students, along with the guidance of their instructors, assist in the making of the courses of study for the class to follow, individual differences can be really taken into consideration. This, I am told, is one of the requirements of good-quality instruction.

Some of the student unrest now found throughout our nation's campuses is caused by courses being offered in which the students received little or no consideration. In this modern world, change is the "thing". If you are not flexible and cannot bend with the breeze, you will surely break, which could mean losing your students' interest. All courses in industrial arts should be planned with the students' interest in mind. A student must be taken from where he is and moved forward. It is of great importance that students be made to see themselves within the total situation; to see how they are to be a part of the whole environment of the technological world in which they are to reside. They should be taken into the planning of course structures so that things will become relevant and meaningful. When this comes about, much of the student unrest will disappear, and you, as teachers, will find a more relaxed and receptive audience with which to work.

You older people talk of the "Generation Gap" and of a lack of understanding and communication that causes some alarm in dealing with young people today. I believe that much of this is due to the fact that youth is more exposed to facts and true information than the older generation was at our age. Since today's students are more knowledgeable than they were in years past, they want to feel that they are having a part in planning things with which they are to become involved. Television and radio give out more facts and newspapers print more information today, than they did in days gone by. This in itself makes the student of today a more knowing individual. However, the greatest stimulus that we have today is the feeling that we want to belong to something. By having only a small part in the planning procedure of the course, a student is given that feeling of belonging to something that he feels can be of help to himself. And the instructor will also receive a feeling of helping someone.

The rapid advance of our technological information (I am told that we are doubling every eight years the amount of knowledge that is in the world) makes it imperative that teachers orient their courses to the student as well as with the student.

Although technology cannot be taught in an industrial arts class and be properly kept up-to-date as it changes, occupational information can and should be taught by every industrial arts teacher. Occupational information refers to that general knowledge necessary for a person to serve himself and society adequately in certain vocations. It refers to the ability to work and cooperate in group environments. In industrial arts courses, this concept is easily made real. The instructor can help the student work his own problems out and show the student how such problems can apply to the technological environment. The student can also learn to work and cooperate with others in the industrial arts curriculum.

Another important part of student-oriented industrial arts courses is creativity. Creativity is a vital component of industrial arts, for it is through creativity that the student can best express his feelings and ideas. When we consider how we shall analyze a problem, how we shall go about attacking the problem, how we shall fight our way through the various obstacles that may appear in our path, there is plenty of scope for originality and creativity. A point should be made here. It does not matter which method of solving a problem is best; indeed, that would be a denial of the "creativity" or "originality" idea. The point is that there are many methods, and students can and do invent their own. The early introduction of important ideas does not merely aid learning--it also facilitates creativity. But most important, the teacher should listen to the ideas of the student. The instructor is often handicapped by a fearfulness about new ideas in his particular field by excessively great commitment to his own beliefs and experiences and by the unpredictable nature of students' questions. If a teacher took this attitude, a student would have the feeling that only one method exists, and it is therefore foolish to try something different.

I would now like to bring to your attention four parts of the definition of orientation--namely, time, space, purpose and persons. First, let's consider time. A student needs to study courses that are relevant to the time or age in which he lives. Studying material that is even five years out-of-date causes students to lose interest very rapidly. I think that the consideration of space is very relevant, also. It is very apparent how rapidly the world is "shrinking". Today it takes only a matter of a few seconds to call a friend in Australia from here in Louisville, whereas fifteen years ago it would take as much as half an hour. Today's students need to be helped to adjust to such changes; and it is up to you as instructors to aid us.

Now let us look at purpose. Everyone needs a purpose in life, and we students are certainly no exception. If we do not find a purpose, we will surely end up like the hippies. It is your purpose as teachers to help us find our own "place in the sun". Lastly, I would like to say that persons, the final requirement of successful orientation, will have a very lasting influence on the youth of today; for, as it is well put in a poem, "no man is an island". Because no one can live without others, all youth need to learn to cooperate with other people. You as teachers can help us students learn this valuable personal quality in the classroom.

As you can now see, orientation is a very valuable asset to the learning process of today's students. The general purpose of student orientation is to give the student an opportunity to express himself in something that can hold his interest. It needs to be something that has the student in top consideration. This is the purpose of such a course of study for industrial arts. It is my feeling that by taking the students along rather than telling them the direction you plan for them to take, you will find a more happy climate in the laboratory. This feeling will make your job, as an educator, more pleasant and much easier. Students will, I believe, be more enthusiastic in the performance of the tasks before them and will ultimately accomplish more and gain more information. And, to me, this is what teaching is all about.

Mr. Townsend is just completing his term of office as president of the American Industrial Arts Student Association. He is a June, 1970, graduate of Crane (Texas) High School.

Man: end or means?

Jack R. Frymier

Let me begin by saying some very obvious things. (Maybe everything I say today will be obvious, I don't know.) The title of my paper today is, "Man: end or means?" As I look at the banner behind me, "Man⇆Society⇆Technology", I think that's an appropriate title.

Let me begin, however, by stating some things that are almost obvious at the cliché level. One need not be very bright or thoughtful or perceptive or knowledgeable or very much of anything to recognize that these are dramatic, fast-moving, changing times. It hasn't been too many years ago that Jules Verne wrote Around the World in Eighty Days. Almost in our lifetime that story has changed from around the world in 80 days to around the world in 80 hours and from around the world in 80 hours to around the world in 80 minutes. We now stand perched on the brink of, in fact, moving man around the world in 80 seconds or less. We now have, at least theoretically, the capability of transmitting man by means of electronic impulse. Scientists and technologists have developed conceptually ways of transmitting matter by means of electronic impulse. The odds are very, very great that before all of us in this room are gone, man will have devised a way to equate transportation with communication. We will be able to move ourselves from here to there with fantastic speed, in an instant and in a moment.

We have telephone, telegraph, television, maybe we will have a telepeople machine, where I can go from here to New York (with special rates after nine o'clock). That sounds fantastic, I know, but that is the kind of era in which we are living. And that fantastic change permeates everything we do and everywhere we go and every place we work. We all know that. This is the fastest-moving age man has ever lived in, and you and I are now a part of it.

It seems to me that it is appropriate that those of us who work in schools ask ourselves the question, "Are we, in fact, keeping pace with the times? Are we keeping up, or, hopefully, are we ahead? What are those of us who have responsibilities for working with young people doing in these very dramatic and fascinating but frustrating, these climactic but chaotic kinds of times? Are we making the kinds of adaptations in our schools? Are we modifying our efforts, our procedures, our programs and our ways of working to keep pace with this dramatic tenor of the times?"

If one looks at our educational effort, if one looks at what we have done in recent years, the first generalization one is apt to make is, "Yes, clearly we are trying to change." Those of us who are working in education are trying dramatically and have worked fantastically hard to modify education in recent years, especially during the last fifteen years. We have changed the components, we've changed the relationships--we've changed a great many things about education.

I like to think of these change efforts as hypotheses for change. They are hypotheses because we almost never have a laboratory where we try things out fully and effectively before we put them in the school. Sometimes we do, but generally our practice in education is otherwise. Generally, someone gets an idea, somebody gets a notion, somebody gets a new proposition, and we try it out "on the job", so to speak. And we hypothesize that if we change this or we change that, something will work out for the better. Over the years we have hypothesized that a number of things ought to be changed in education. For example, there have been a whole series of content hypotheses for change. What we have really said is that we can change the nature of the subject matter that we teach if we can clean up the language, if we can tighten up the logic and if we can resequence this information in a different kind of way – then, maybe then, we can make a significant impact upon the lives and minds of those we teach.

So we have had a whole host of changes in the content, the subject matter, the disciplines that we employ to help young people learn in schools. Most of these have some kind of alphabet title – BSSC physics, BSCS biology, SMFG and all those kinds of programs. We are trying to change the basic substance that we teach, and that's true in industrial arts also, you know very well. I think of these change efforts as content hypotheses for change.

There have been other kinds of change efforts that we've proposed, too, modifications of the methods that we employ. I think of these as methodological hypotheses for change. We've changed the way in which we work and the nature of the interaction with teachers and pupils. That's what educational television is, that's what computer-assisted instruction is and all different kinds of levels. We've tried to change the ways in which we work with young people, hoping that by modifying our techniques and our processes and our methodology, we will be able to help young people learn more, better, faster, retain it longer, forget less of it. We would be able to modify their behavior in the appropriate direction more consistently, and so forth. Methodological hypotheses for change.

There has been another series of change efforts which involve the organizational components of education – time, space, the staff, the resource relationship. I think of these as organizational hypotheses for change – the modular scheduling, the nongraded school, all those kinds of things – team teaching, various ways of grouping people. Even at the district level, we've changed tremendously the way in which school districts are organized and whole new concepts of district organization, especially as it relates to industrial arts and vocational-technical education. Those are organizational hypotheses for change.

We've also tried things like more research. As people we've poured millions and millions of dollars into a study of the phenomena that are involved in teaching and learning. We've tried to see, what is teaching really like? What is the nature of learning? What is the nature of motivation? What is the precise result of teacher-pupil interaction in certain kinds of ways? We said, maybe if we invest our time and the best talent we have, maybe then we can understand the fundamental phenomena that are involved in education – then maybe we will be able to generate a breakthrough in education, just as we've generated breakthroughs in medicine and breakthroughs in engineering and breakthroughs in communication and breakthroughs in transportation. Maybe by tremendous efforts in research, we can generate a breakthrough in education. I think of this as a kind of a research hypothesis for change. Or research hypotheses for change.

Well, certainly we've tried to change. We ask ourselves, have these changes paid off? Are schools better today than they were ten or fifteen or twenty or fifty or a hundred years ago? If we ask that question honestly, and if we look at the data that are available, anybody who studies those data will be sorely disappointed. Obviously, schools are different today from what they were ten or twenty or fifty or a hundred years ago. They're different, but, the question is, are they better? On that question we're lacking in very good data. It's obvious, for example, that children today do many things better than they did twenty or fifty or a hundred years ago. They read better, they write better, they spell better, they compute better, they're better at social relationships, they're better at human relations skills. But no matter how we measure those changes, those differences are very, very, very, very slight. If we're measuring them, for example, in standardized achievement tests, it may be one-tenth of a grade level, or two-tenths, or three-tenths of a grade level at the most.

It's also very evident that wherever we look, there is tremendous dissatisfaction with education. For example, almost one-third of the kids who start school in the first grade quit before they should finish twelve years later. And they quit because they hate it, and they hate it with a passion, and they wouldn't go back of you drove them with a club. Any organization which loses almost 50 percent, and loses more than 30 percent, of its clientele, and which develops those fantastic negative feelings, is pretty sorely pressed to demonstrate that it's doing a superb job.

There is also evidence that there is widespread dissatisfaction, in the profession, outside of the profession. But why is that so? Why is it that people who recognize the need to change and who have tried tremendously hard to change education in a great many ways – why is it that those changes have not paid off? Why haven't we been able to make the kind of improvement that we all hope for and that we all work so hard for – why is that so? Well, I think there are many reasons. I will try to share with you a few and I want to share what I think are some very pervasive things that relate to that.

I think that some reasons lie in the fact, for example, that as a profession we've tended to do a number of things wrong. We've tended to do what I call, "Ask the wrong questions". We ask the wrong questions about programs, we ask the wrong questions about our educational operations. We say, for example, "How many schools are using the new industrial arts program? How many schools are using the new physics program? How many schools are using modern language laboratories? How many schools are using the new biology? How many schools are using the new math? How many schools are non-graded? How many schools are using team teaching?" Those are all frequency questions. And if you ask a frequency question, you get a frequency answer.

Now implicit in the frequency question is the fact that there must be something behind this, that if a lot of people are doing it, it must be worthwhile and it must be good. Now if you try to justify something as right just because it exists, you get into trouble. You have to justify crime or prostitution or disease as good and worthwhile just because they abound. That's a very shaky and very shoddy kind of logic.

It's also very, very evident that if we equate goodness with widespreadness in education, it doesn't pay off. For example, about 1959, I think it was, there was a first survey done in the United States of how many schools in the United States used language laboratories. There were 14 high schools in America in 1959 – that's just 11 years ago. Fourteen high schools in America used language laboratories. By 1962 that number had increased to 10,000 and, by 1964, that number was supposedly 14,000 high schools, now using language laboratories. And so, the notion is, it must be good, it must be worthwhile, it must be paying off. To go from 14 to more than 10,000 in just a very, very short period of time obviously is an indication of progress; obviously we're moving in the right direction.

But it isn't so obvious. The fact of the matter is that while we of the nation have spent three quarters of a billion dollars on language laboratories, we don't have a hundred good pieces of research to demonstrate whether or not they are effective. And out of those studies that have been done, about a third of them indicate that the kids learn more, about a third of them indicate they learn less, and about a third of them indicate no significant difference. When anybody tries to make inferences that the language laboratories are new and better and paying off, he is obviously not looking at the hard data. And we put a tremendous investment in these things, based on the notion that if more people are doing it, it must be worthwhile. In fact, the best studies that have been done in that area indicate almost exactly the opposite – the ones with the biggest numbers of kids and the most carefully-controlled variables, and so forth. And that's very disappointing. Now I don't know why that's so. Everything I now that language laboratories have done caused me to believe that the new way is a better way. But I think if it is a better way, it'll show up in research, and in fact it has not.

Now we've asked the wrong question. We said, "Do we have it because everybody else has got it or not?" We've done the same thing in physics and math and biology. In 1957, for example, there was not a high school in the United States that taught PSSE physics, because it was just being worked on at that time. Last fall, when school opened up, more than 60 percent of the high schools in the United States that taught physics taught PSSE physics. The inference is, it must be great – look how widespread it is, everybody's using it. We tend not to be conscious of the fact that during that same 13-year period of time, during the 13 years in which the new, modern, the best physics, developed by the best scholars with the best support of the government, during that period of time the proportional enrollment in physics in United States high schools has decreased 22 percent. During the time when we've had fantastic pressure and encouragement and guidance to move people in a technological, scientific, physics kind of direction, we've got a new program which is supposedly predicated upon the fact that it will help kids learn, discover the structure of physics, the way in which physicists work and will motivate them to go on. During that same period of time, as this new notion has spread more and more widely, the kids have consistently said, "No, no, no, no, no." Now the time may come when all of the schools teach it and none of the kids take it--then we'll be doing a perfect job. I'm not sure. But if you ask the wrong question – How many schools are using it? Is it widespread? – that's the wrong question. But I think one of the things that we've tended to do as a profession is to ask the wrong question. We've also, I think, operated on the basis of erroneous assumptions, and I'm not going to talk about those. I think we've also tried to manipulate the wrong variables. I'll talk about that in just a minute.

We have tended basically as a profession to look at the variables "out there." We said, maybe if we change the size of the class or the color of the print or the sequencing of the ideas or the way the kids are grouped or the length of period - maybe if we change all those things "out there," then maybe education will change.

Now anybody who has thought about it for 30 seconds, or anybody who has studied any of the research, as I happened to have had a chance to do in my kind of work, knows very well that the most powerful ingredient in education is the human one. If we want to change education, we have got to change ourselves - our attitudes, our values and our ways of working. Now anybody knows, given the choice of changing the textbook or changing the teacher, which will make the greatest impact. Anybody knows, given the choice of changing the sequence of information or changing the nature of teacher-pupil relationship, which will make the greatest difference. But as a profession we have invested our time and our energy in trying to change those things "out there".

Evidently we've said, maybe if we change all of those things, we can stay the same and the kids will still learn more. But, if you don't know it yet, that just won't work. If we want to change education, we have got to change ourselves and our ways of working. The thing that counts in education is us. The most crucial variable in education is the human one, and if we want to change education, we have got to find a way to develop and cultivate and nurture this human variable to make it more powerful and more meaningful and more effective in the way it works with young people.

But we haven't been able to get hold of that very well, so we tinker with the time and we tinker with the grouping and we tinker with the size of the class and we tinker with all that other stuff. But we stay the same. For that's erroneous and naive on our part to presume that we can manipulate the minor variables and leave the major ones alone.

For there are other kinds of things that we've done wrong, I think, too. I don't think there is any question that the "no significant difference", which is the most common finding in education, is also a function of the fact which is very tough for us to seem to be able to accept - that individuals differ. People are different. And the fact of the matter is that most of those of us who work in education have offered solutions of a programmatic nature for groups. In other words, we take the old math out and we bring the new math in. We take the old industrial arts out and we bring the new industrial arts in. We take the old way of teaching foreign language out and we bring the new way of teaching foreign language in. What we do is to substitute one group solution for another group solution. And we presume that somewhere out there, there must be a general way of working which is best for all people. Well, that's nonsense. God Himself could not devise a program which would meet the needs of all individual people, because people are different. There is no one method, there is no one way, there is no one content, there is no one organizational structure, there is no one kind of experiential device which will meet the needs of all kinds, because people are different. God made them that way, and any individual who tries to find one program which will meet the needs of all kids is naive. But when you give naive people power, that's dangerous. And that's where you and I are. But I think that's the kind of assumption which is utterly naive, and that we've got to examine in our own operation.

Now to support that, I think in recent months, the last two or three years especially, the young people of the world and in the United States especially have been sending messages to those of us over 30. They send us communications. They're trying to send us information about how they feel, about what they think is wrong, about what they think ought to be changed, and so forth. Over these months I think they've sent us messages of different types and in different forms. Now many of us, especially those of us over 30, are disturbed sometimes by the form of the message. We don't like the fact that it's loud. That they are profane. We don't like the fact that they wear their hair long. We don't like the fact that they cuss at us and don't seem to listen to us. Well, I think that if we try to understand both the content of the messages and the frustration which is behind the young people, that might be useful to us. I think what really has actually happened over the years is that for a long time a lot of people who were affected by education, who were working in it, tried to change it. They kind of sat in the back row, and they kind of waved their hands, and they said, "Hey, hey, you know what? I got an idea. I know a little bit about what I'd like to do. Why don't you try this?" You know. "Why don't you do it this way? Why don't you pay attention to me?" And they begged and they pleaded for a long time to be listened to, but we didn't pay any attention.

And now they're saying, "You blankety-blank, listen to me!" You know, we come up tight on that. We listen and we are all upset and we are all disturbed. What's the matter, we say? What'd we do wrong? You know. And we get all upset because, all of a sudden, their patience is worn out, and they swear, and we say, you ought not to talk that way and stuff, you know. It's okay if we talk that way, but they ought not to talk that way you know. I think their patience has worn out. And I don't for a moment condone the brutal, sadistic, destructive kind of behavior that some young people are engaging in today. I don't mean to imply that for a moment.

But I do think there is, behind the actions of many young people, a series of messages that they're trying to send to us, and I think that those messages are related to what we do, and I think we have to try to hear them. If I try to listen, if I try to figure out wha those messages are saying, I think they say something like this. One of the messages that kids are saying is, "Life is worthwhile," "Life is worthwhile." Another message tha they're sending is that "the system has to be changed." "The system has to be changed.' A third message is, "The school is a sorting machine rather than a growing, cultivating nurturing institution." It sorts people out. Slaps them into categories. A fourth message is, "We want a piece of the action. We want to be there where the action is, and we wan an opportunity to participate in that."

Let's look at those four messages which the kids are sending us, and see if there is any validity to the content, even though the style may be obscene or disturbing to us. The kids are saying to us, "We think life is worthwhile. We think that people count. We think that life is important." And furthermore they're saying to us, "We don't think you believe that. We know you say that life is worthwhile, but everything you do supports the opposite. For example", they say, "how can you possibly say that life is worthwhile and spend the fantastic resources of this great nation building death-dealing devices? How can you do that? How can you continue to build fantastic weapons of destruction and say that life is worthwhile?" Overkill is not a cute military phrase. It's a precise description of the fantastic capability which already exists – not hypothetically, not theoretically – but already exists to destroy life as we know it. We have more than 53,000 nuclear weapons. If we started to drop one today – and each one of those weapons is hundreds and hundreds of times more powerful than those bombs that were dropped on Nagasaki or Hiroshima – if we started to drop one bomb a day, it would take 137 years just to use up the existing supply. And the kids say, "You know, life is worthwhile. We don't think you really believe it. Life is important. Quit building all that nonsense to destroy life and put something into the business of building life and nurturing life and saving life and creating life. Life is worthwhile. How can you possibly talk about the business of building weapons of destruction" – for example, we have biological warfare material, one gallon of which is enough to destroy eight billion people, more than twice the population of the whole world at the moment. The governor of the State of Oregon is pleading right now with the President of the United States, asking him not to bring nerve gas from the Philippines or the Pacific or somewhere and store it in his state – "How can you possibly say life is worthwhile and behave in those kinds of ways?" the kids are saying. "It doesn't make sense. You're hypocritical, you're inconsistent." How can you possibly encourage kids to learn how to take human life and call that higher education? That is what ROTC is – organized instruction in human destruction.

I work in an institution which is the largest producer of ROTC graduates in the United States. I also work in an institution as an individual who has spent five years of his life totin' an M-1 rifle around the world, supposedly in the name of freedom. I believe in freedom. I fought for freedom and I have seen men die for freedom. I think if freedom is worth fighting for and dying for, it is absolutely worth preserving and practicing in schools. I do not for a moment believe that it is possible to develop a free people by enslaving them while they are young. And the kids are saying, "Why do we have to learn how to kill our fellow man? How come? Is it possible to teach people to kill and call tha higher education? That must be lower education. It can't be higher education. Cut ou that nonsense. Life is worthwhile. Pay attention to us." And we don't listen.

It has been less than a year since President Nixon announced that we were going to proceed with the development of an anti-ballistics missile system. Less than a year The day he made the decision, it was obsolete, because, the day before, Apollo 9 demonstrated the futility of the whole argument. Apollo 9 was at that time in orbit around the earth, going around, around and around. The plan was to drop Apollo 9 into the Atlantic Ocean, but a storm arose in the Atlantic. So they changed the splashdown from the Atlantic to the Pacific. And so in a matter of hours, we changed the precise point of the splashdown from someplace off the point of Cape Canaveral to someplace in the Pacific Ocean. Technologically we brought that capsule down to within a few hundred yards of wha was not even a predetermined target. Just because a storm arose. Now anybody who does not see the implications of that for anti-ballistics missiles is naive. If missiles come they will not come from Siberia across Alaska to Canada. They're going to come out of earth-circling satellites. There is no protection against those. There is none. And yet we are already committed to spending billions and billions of dollars, what some people estimate may be the biggest expenditure ever made by this country, on a weapons system which is already outdated by our own technological developments.

Last summer, for instance, you may recall the MIG fighter that flew from Havana and landed at Homestead Air Force Base in Florida. We don't seem to recognize the implications of that. The fighter left Havana, the pilot flew very low across the ocean. He didn't pay attention to the rules. For example, he didn't fly high enough for our radar to pick him up. We didn't know he was coming. We didn't know he was coming until just a very few minutes before he landed. When he landed he came in with his wheels down. Now anybody knows that when an aircraft comes in with its wheels down, that's a sign of friendliness. He might have had an atom bomb on there. He landed within a few hundred feet of the President's jet, Air Force One. He could have blown the whole south end of Florida right off the map. But we don't seem to recognize that if war comes, it might come that way. We keep thinking it's all right if we spend fifty billion, one hundred billion or four hundred billion dollars on a weapons system which doesn't make sense, because obviously if people are going to play the game they are going to play it according to our rules. "How utterly naive can you be?" the kids are saying. "Life is worthwhile. Let's build something that's human-creating and human-nurturing and human-preserving, rather than human-destroying. Life is worthwhile, but we don't think you believe it," they are saying.

I think their message is coming across. I think we have to pay attention to it. How about the other things they're saying? "You have got to change the system," they're saying. "The system has to be changed." Those are the words which they typically employ. Sometimes they're talking about the political system, sometimes they're talking about the economic system, but often they're talking about the educational system. What do they mean when they say the system has to be changed? Is there something fundamentally wrong with the system? I think there are a lot of things right about the system, but I think that there are obviously possibilities for improving it. I think without question in the field of education we need tremendous change in the system as a system. Apart from the program, apart from the people, I think the system has to be changed.

For example, any fully-functioning social system that I know anything about is characterized by the fact that there are three separate aspects – three separate entities, three separate functions which are performed. One of these functions is the planning, the conceptualizing, the hypothesizing, the direction-setting aspect of the system. Another part of it is the doing, the implementing, the accomplishing, the effecting part of the system. The third part of the system is the judging, the evaluating, the assessing, the reflecting part of the system. Now in any fully-functioning system, these three pieces function separately, and each one of them has a power, but at the same time they are all delicately-balanced and poised and related to one another.

There is a separate group which performs each function. President Nixon found that out sorely yesterday. It hurt his ego and it hurt his pride. He proposed to Congress and to the Senate a name for confirmation (for judge of the Supreme Court), but the Senate rejected it. The Senate is a group separate from the President. One group plans, one group accomplishes and one group judges. That is beautifully illustrated in our system of government – the legislative, executive and judicial branches. But it is also illustrated in almost any other kind of concept you want to look at – whether it is science, economics, and so forth – except education. In education, one group plans, another accomplishes, but there is no judging or evaluating group which has a power of its own. Obviously people make judgments, obviously people make inferences and assessments, but their judgments don't have power, their judgments don't have precision. Their judgments don't have influence, except in a very gross and crude kind of way. And furthermore, what we actually have is a group of people who plan, who conceptualize, who give direction. These are the governing boards of education – whatever they are called or at whatever kind of level – the school board, the board of trustees, etc.

We have the implementers. That's you and I. The professionals. We convert policies into programs. We convert ideas into practice. We convert general notions and general purposes into educational hardware and educational decision. But we do not have anybody to perform the evaluation role. We don't have a separate group charged with the responsibility of assessing or holding us accountable for what we do. Let me cite two or three illustrations, if I can, to make that point, because I think that is a very serious flaw in the system. When the kids say the system has to be changed, I think they are right.

Ten years or so ago, when I worked in Orlando, Florida, as Director of Instruction, I picked up my telephone one day when it rang, and I said, "This is Jack Frymier", and some guy on the other end of the line said, "I want you to make those kids quit killin' those fish". I said, "What?" "I want you to make those kids quit killin' those fish." I said, "I don't understand what you're talking about. You'll have to tell me the whole story." He said, "I'm so and so. I run a pet shop. Every day at 8:00 a.m. a school bus comes and stops in front of my pet shop and stays there until 8:20. At 8:20 another school bus comes, and some of the kids get off of one bus and get on the other bus. Then the two busses go on. But between 8:00 and 8:20 some of those kids get off of that one bus and come into my pet shop and they buy fish. They take them to school and they kill them. I want you to make those kids quit killin' those fish." I said, "Why don't you quit selling them the fish?" And he said, "Now don't you give me a hard time, buddy!" He said, "Aren't you the Director of Instruction in this school district?" I said, "Yeah." He said, "Aren't the biology teachers part of the instructional effort in this district?" I said, "Yeah." He said, "Aren't the biology teachers supposed to do what you said?" "Well," I said, "I'm supposed to have some kind of influence over them." He said, "I want you to make those kids quit killing those fish." I said, "Okay", and I hung up the phone and laughed like ----. That was the funniest thing that happened to me all day. I didn't pay any attention to him. That's the way it is in education. We pay attention if we want to or we don't pay attention if we don't want to, but we decide.

Those of us who are responsible for implementing the decisions are also responsible for judging the decisions. We make the decision, either way. Now if I'd gotten two or three telephone calls, I might have gotten a furrow in my brow. If I got four or five telephone calls, I might have changed our whole biology program, based on that little bit of information. Now what we have in education is a system in which those of us who work in it not only have to implement, but also have to judge. And that means we're judging ourselves. And that means that there is a kind of contamination of the process. We work hard. We try like the dickens. We invest tremendous amounts of energy and money and time and then we turn around and say, "Are we doing a good job?" Well, it's awfully hard to say we aren't doing a good job after we've poured all that stuff into it.

Let me take another illustration, for example. On our campus, The Ohio State University, we have had for a number of years what's called a speaker's rule. The speaker's rule was passed by the board of trustees. It was designed specifically to keep certain people from speaking on campus – basically people who have communist inclinations and communist leanings. Now the law, the rule, was passed and adopted by the board of trustees, and over a period of time a lot of people felt very uncomfortable about the rule. They said, "You know, first of all, it's a direct violation of the first amendment of the Constitution, which guarantees freedom of speech, press, religion, assembly, petition. It doesn't really make sense to deny people the right to speak, especially in a university setting, especially when men are concerned with the pursuit of truth. It doesn't really make any sense to cut off debate, to limit discussion." And so students and faculty and a lot of other people kept complaining, and there were committees at work and there were protests in The Lantern, The Columbus Dispatch and articles in Atlantic Monthly and Harper's and the New York Times. And over a period of time a tremendous amount of discomfort developed. Finally a student group got a committee going, and they kind of wobbled their way through the university community, and a faculty group got working, and they kind of wound their way around the university community. And these two groups came to the president's office, and they said to the president, "You know, a lot of people around here are unhappy about the speaker's rule. Will you please go to the board of trustees and ask them if they'd change it?" The president thought about that awhile. He said, "Okay, I'll do that." He went to the board of trustees and he said, "You know, there are a lot of people around here who don't like the speaker's rule. Will you change it?" The board of trustees thought about that for a little while, and they said, in effect, "Who made that rule, anyway? Oh! We made that rule, didn't we? Oh, we think that's a pretty good rule. No, uh-uh, we're not gonna change it." They didn't. It changed several months later, when a couple of guys missed the meeting, and the balance of votes switched and it went through.

But the fact of the matter is, at the present time, as it is presently conceptualized – at universities, in public schools, in our whole realm of education – the system is conceptualized in such a way that those who have responsibilities for making policy are the same group who judge the worth and the relevance of that same policy. If we did that in government, for example, that means that we would allow Congress to determine the constitutionality of its own laws. We deny that right to Congress. That right is reserved to another group, and that group has power. That group has an influence of its own. When we sometimes talk about the power of the Supreme Court – "What the ----, they're just nine old men. Oh, they can't do anything." If people don't live by those rules, there's nothing they can do. The marshalls don't work for the court, the marshalls work for the President. Our system is delicately balanced in such a way that we found a way to use corrective feedback in order to improve. We found a way to process criticism and to convert criticism and complaint into positive program change. We can do that in economics. Our whole system of free enterprise in economics is based upon the fact that when somebody doesn't like something, he can turn it down, and the people who produce products have to pay attention to the feedback. But in education we don't have to pay attention to the feedback. We pay attention if we want or we don't pay attention if we don't want, and *we* decide.

Now that's a flaw in the system. When the kids are saying the system has to be changed, I think they're right. I think we have ways and mechanisms and means and tradition which allow us to insulate ourselves from the system. We're not accountable to them or to anybody else. Let me cite one more example and then I'll go on.

A number of years ago a man in our state was elected governor on a conservative platform, and the first day he came into office he fired everybody in the state who had been hired in the last 90 days. The law allowed him to do that in civil service and so forth. Every state agency got its budget cut.

In our Department of Education we immediately had our budget cut $26,000.00. We didn't know what to do, you know. The kids were there, we didn't want to shoot them. We didn't want to send them home. We didn't know what to do with them. But we didn't have any money and so we said, "What should we do? Should we cut out programs? Should we increase class size? Should we increase the number of student teachers people have to supervise? Should we fire faculty? What should we do?" We talked about it and thought about it, and we finally made a decision. We said, "Let's absorb all of the loss at one point, at one point in the program, and let's keep everything else the same." And so we took a class called Introduction to Education, which was required of all students. You had to take if if you wanted to be certified to teach in our institution. You had to take that course. That course had been taught by regular faculty and by some graduate students, but in small sections of about 30. That year we put all of our financial losses into that one thing, and that class went to 1100 students, and we put a graduate student in to teach it. We said, "Good luck, buddy." That's what we did.

I used to watch that class – 1,100 people – that's a lot of people, you know. There's some kid, with a master's degree, working like the dickens to get a doctorate and taking twelve, fifteen hours on the side and writing a dissertation, up there trying to teach that class.

I used to ask myself, what would happen if some guy in that class, some kid out there said to himself, "How come I have to take this class"? Suppose he walked across the street – we didn't have an auditorium on campus big enough to teach it in; we had to go to the state museum. So I asked myself what would happen if he walked from the state museum over to the Dean's office and knocked on the door and said, "Hey, hey, Mr. Dean! Tell me why I have to take Education 108." You know what the Dean would have said? He'd have said, "You want to be a teacher, don't you?" And the kid would have said, "Yes." And the Dean would have said, "Well, you have to take Education 108." But suppose the kid was one of those kinds of obnoxious kids and he said, "Hey, buddy, don't give me that nonsense. Can you prove to me that I'll be a better teacher if I take that course than if I don't? I mean, look, you're *making* me take it. I don't have any choice. It's required. What kind of evidence do you have that I'll be a better teacher if I take that course than if I don't?" You know what the Dean would have said? Huh? He'd have probably said, "Have you thought about agriculture, or maybe you ought to go into engineering." Or he'd have tried to counsel him out and get him out of the field of education. But suppose the kid was really one of those blistering kids who walk around campuses today, and suppose he said, "Now, ---- --, don't give me that nonsense, buddy. Can you prove to me that I'll be a better teacher if I take that course than if I don't?" You know what the Dean would have done? He'd have drawn himself up to the full dignity of his office and he would have said, "Young man, that course is good because we say it's good. It's good by definition. We don't hypothesize that that's an effective course, we postulate it. We don't have to prove even to ourselves that what we're doing makes sense. Not even to *us*."

Now I submit that when you work in that kind of system, that's a fantastic amount of power. And when the kids are saying, "The system has to be changed", I think they're saying there has to be an accountability mechanism there. There has to be a way to find out whether what we're doing does in fact make a significant difference. Well, the message that they're sending is that the system has to be changed. I think there's a validity to it.

Another message that they're sending: The school is a sorting mechanism. The school sorts people out and categorizes them and slots them. We give grades. Grades become money because they're scholarships. We determine people's lives. We label people. We categorize people. Kenneth Clark's whole notion, for example, about the self-fulfilling prophecy is that by labeling a ghetto kid as a poor achiever, a poor reader, he ultimately learns to do that, and he ultimately learns to behave that way, because we have labeled him that, and that's self-fulfilling prophecy. The kids are saying, "You know, the school is treating us like potatoes. We run through here and you slot us out and drop us here and drop us there and put us there and do this to us. We feel like we're being done to. We're being sorted out. The school is serving some other agency" – sometimes they say the Defense Department or sometimes they say somebody else. But they feel that the school is a sorting machine. It's not a growing, nurturing, cultivating, enhancing institution. It's an institution which sorts people out. It puts them into slots and they resent that.

One of the other things that they're saying, of course, is, "We want a piece of the action. We want a right to determine the direction, the nature of what's going on with us. We want a say in what's going on, in the courses that are taught, the activities which we're involved in, the methods that are involved, the evaluation procedure, the organizational plan. We want a part of that. We want a piece of the action." Those kinds of messages are being sent to us loudly, profanely, sometimes politely, sometimes systematically, sometimes in writing, often in yelling form. Life is worthwhile. The system has to be changed. The school is a sorting machine. There are other kinds of messages that they're sending – I just picked out three or four.

Now what are the implications of those messages? What are the implications for those of us who are concerned about kids in school? I think behind all of those things the kids are saying, "We're being used. We're hollow. We feel prostituted. We are means to somebody else's end. And we don't like it. Man is the end," I think they're saying. Man is the end. At the present time I think most of the kids feel that they are the recipients. They are a means to somebody else's end. And they are questioning that severely. And I think their question has a legitimacy. I think their question has a validity. I think we have to find a way to see whether or not what we're doing in educational practice is consistent with what we feel is right – not only what they yell, because I know very well that you don't get verification by volume, and some of the kids think that is true. Things are right just because you say them loudly. But at the same time I think there is a validity to their content if we can sort it out and if we can listen to it.

So let me move, if I may in my discussion, to some kind of abstract, theoretical points about program and curriculum, but then try to relate them to the kind of discussion that we've made.

People who are concerned with curriculum development, people who operationalize curriculum in schools – translate ideas into educational practice, if you please – are people who employ knowingly or unknowingly certain kinds of assumptions about education. For example, curriculum theorists would suggest to us that there are three fundamental sources or areas that we go to when we determine the purposes or the directions of education. There are three areas where we get information and inspiration. One of these areas is what we know about the nature of knowledge. Another area is what we know about the nature of society, and a third area is what we know about the nature of the individual.

The nature of knowledge. We've learned a lot in recent years about the structure of the discipline – the fundamental facts, the generalizations and principles, the ways of the inquiry which are unique and peculiar to any particular discipline. We've learned an awful lot about the nature of discipline, and that's one of the areas to which we can go when we say, "What should schools be about? What direction should they go? What objectives should they pursue? What purposes should they strive to achieve?"

The second area of information, or source, if you please, is what we know about the nature of society – changing cultural patterns, expectations, social values, norms, those kinds of things.

The third area is what we know about the nature of the individual – motivation, personality structure, perceptual style, cognitive abilities, the nature of intelligence.

Now anybody who operationalizes education inevitably draws upon these three sources. What we naively think – those of us who build program – is that we consider all of these in a kind of an equivalent way. We'll draw some from knowledge and some from society and some from the individual and we'll build a program which will meet all of these needs. But that doesn't work out in practice. In practice what actually happens is that we presume that one of these sources is primary and the others are secondary. For example, if we presume that what we know about the nature of knowledge is primary, and what we know about the nature of society and the nature of disciplines is secondary, that represents, if you please, a particular kind of philosophical posture – a statement or an assumption about philosophy which relates to curriculum. It represents one kind of an assumption. If you translate that into educational practice, you get a departmentalized kind of school, a school in which subject matter is predominant.

The second kind of assumption is, what we know about the nature of society is primary. What we know about the nature of the disciplines and individuals is secondary. If you build that kind of assumption into practice, then you get an entirely different kind of thing. You get a group-centered, a socially-oriented, the-school-exists-to-serve-society kind of school.

The third thing is if we presume that what we know about the nature of the individual is primary and what we know about the nature of knowledge and the nature of the society is secondary – that represents an entirely different kind of educational program, an entirely different kind of assumption.

Now people who work in schools can use one or two or three, but they cannot at any one time use all of these.

Now my value structure, which I want to try to share (and I recognize it as my point of view), is related to the notion of "man - ends or means", grows out of my understanding of the kind of static that's coming from the kids and my assessment of things, and suggests that we ought to, from my values, adopt assumption number three. What we know about the nature of the individual is primary – what we know about the nature of society and disciplines is secondary.

In other words, to say it another way, Man is the end, subject matter is the means, society is the result. I don't think that man ought to be used to achieve social ends. I don't think that man ought to be used to achieve discipline ends. Man is the end. And those of us who work in schools have to find a way to build program in such a way that we truly do meet the needs of individual kids. We do serve their needs.

But the fact of the matter is we don't know what their needs are. That's the real dilemma. That's the real trouble. Those of us who work in education equate wants with needs. We say if a kid wants that, he must need it. Now that's nonsense. I may want a new car but I don't need a new car. I may want a steak dinner but I may not need a steak dinner. We don't have any idea about what people really need in order to maintain intellectual and emotional life. We know a lot of things about life's being worthwhile. We know a lot of things about preserving physical life, but we don't have any idea what's absolutely essential in order to maintain intellectual and emotional life. That's a big problem. I'm not going to talk about – I think that we need to examine it, because I think what we've tended to do in education is to get fascinated with the areas which are of particular interest to us – our subject matter field or trying to serve social purposes – and we're not in fact really ultimately concerned about the needs of kids. Oh, we say we are. Yeah, we say that. Oh! kids are important. Sure they are, now d----t, learn this task, or do that or do this. We try to make them work in such a way that they become the means to serve that particular end. And that's the kind of thing I think they're complaining about. And that's the kind of thing I think we have to examine in our own practice, in our own assumption.

What I tried to say is that kids are sending us messages. They're sending us messages about the importance of life, their disagreement with the nature of the system, about the fact that they think the school serves as a sorting machine and other kinds of things. And they're sending us these messages in a period of fantastic change.

Now I know we've tried to change. I know we've worked terribly hard. I know we've struggled and worked against tremendous odds. But I also know at the present time that we're not doing the job well enough. We absolutely are not, and we absolutely have to change.

I think the thing we really have to change is us. I said it before and I'll say it again. I don't think there's any question whatsoever that the crucial ingredient in education is the human one. The thing that counts is us. If man is the end and subject matter is the means and society is the result, then we've got to find a way to use ourselves powerfully and creatively to make a difference in those kids. That means the assumptions upon which we operate have got to be changed. The space we have to conquer is that space behind our eyes – our values about curriculum, our notions about the importance of subject matter, the purposes we tend to achieve, whether or not we seek kids serving some other end or whether we do think that life is worthwhile, whether we do think that when the kids say they want a piece of the action, we recognize that as an evolution of the spirit of the democracy – the whole reason this country is here. The only reason our nation came to be was that we wanted a piece of the action. And the kids are saying that now. Democracy is an evolving, growing concept. It's not static; it's dynamic. The kids say, "Life is worthwhile." They say, "You don't believe that." They say, "We want a piece of the action and you won't let us have it. You're making the school be a sorting machine – cut it out and change the system." Well, if we want to change those things, the thing we have to change is us. We have to find ways to use ourselves powerfully and creatively to help young people learn.

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Extensions of technology: from utopia to reality

Henryk Skolimowski

I. From Technologies to Technology.

In human history technology has been the proverbial horn of plenty, and yet it is now regarded by many to be humanity's curse. Within the history of science, technology has been considered as an innocent assembly of useful gadgets, and yet it is now seen by many as an omnipotent Frankenstein monster. Have we become schizophrenic in our thinking about Technology, or has Technology so profoundly changed its nature that our stereotyped conceptions of it no longer apply?

To attempt to examine the nature of technology is a nearly impossible task, and yet we have to undertake such an examination if for no other reason than in order to be reassured that we have not become schizophrenic. I shall begin by making a distinction between technologies and Technology (the latter always with a capital "T"). The former, that is, technologies, I shall treat individually. There is the technology of pre-fabricated houses, the technology of paper making, etc. These technologies existed from time immemorial. We can find their presence in the earliest traces of human civilizations. Indeed, the discovery of early civilizations is the discovery of the remnants of early technologies. It will be no exaggeration to assert that early technologies helped to humanize mankind to no lesser degree perhaps than did the moral laws invented by the great prophets.

Technology, as opposed to technologies, I shall treat collectively in its totality. Technology is a specific embodiment of technologies. But its fundamental characteristic cannot be grasped by examining the features of particular technologies. Taken in toto Technology distinguishes itself by its ruthless drive to establish mastery over the external world. It is with this phenomenon – Technology versus the external world – that I shall here be concerned. My task, in other words, will be to excavate the roots of modern Technology. And by the "roots" (of modern Technology) I do not mean the chronology of successive stages of the technological development, but rather the social, philosophical and psychological peculiarities of the Technological Phenomenon. This phenomenon emerged relatively late in human history. I shall argue that its origins belong to the post-Renaissance era. In particular I shall attempt to demonstrate that Technology cannot be separated from the rest of our intellectual history during the last four hundred years. In other words, Technology is neither the thing-in-itself nor a part of applied science, but is an intrinsic part of the rational ideology worked out in the post-Renaissance period; as such Technology must be viewed within the context of this rational ideology. Our present perplexities about the nature of Technology, about its advantages and disadvantages, about its blessings and disasters, are partly the result of our confusion concerning the intellectual heritage that was bequeathed to us from the Renaissance on.

Now, one of the burning issues which various writers on Technology have attempted to settle is: Is Technology natural or unnatural to man? Another issue is: Is our present Technology a phase in a continuous and homogeneous technological development, or is it quite unlike earlier phases? And the third issue is: Is it the case that the flourishing of great civilizations invariably coincides with the flourishing of Technology?

These are interesting questions in themselves. But they are also relevant for the understanding of the present condition of Technology. I therefore will briefly discuss them one by one in order to prepare the stage for the dissection of the technological phenomenon within the framework of what I call the rational ideology of modern times.

To begin with the first question: Is Technology natural or unnatural to man? Modern Technology is monstrously unnatural to Man, argue some thinkers; modern Technology grows from and is a part of the natural equipment of man, claim others. Where is the truth? The truth is that modern Technology is as natural as it is unnatural to man. To put it otherwise, it is neither natural nor unnatural. Is the harness natural to a horse? Are trousers natural to man? (They are now almost a part of our skin.) Is the computer, which can calculate a thousand or a million times faster than we do, natural to man? The answer can be both "yes" and "no" almost in every case. We cannot answer these questions without some *a priori* schema of what is natural to man. In order to justify such a schema, we have to resort to philosophical speculation. Thus, there is no clear answer to the question, Is Technology natural or unnatural to man? because the question is ill-formulated. Before it can be meaningfully answered we have to make many stipulations and assumptions. Furthermore, what is "natural" in one epoch may not be natural in another. Thus the phrase "natural to man" is an historical category; therefore, it should not be treated as if it were universal, timeless, unchangeable.

The second question is concerned with the process of the development of Technology. Has it been continuous? Has Technology been basically the same for millenia with the proviso that we have accumulated more and more of it as the store of our inventions and discoveries has grown? Or have there been some drastic discontinuities so that we can justly say that Technology has changed its character and nature? It is unquestionable that during the last two centuries, particularly after Technology married science, Technology became an altogether different phenomenon, not only in scope but in nature. On the other hand it is undeniable that there have been some continuities. And the question is whether the changes and discontinuities have been more fundamental than the continuities. It is my contention that such is the case. The discontinuities appear to be far more fundamental, not only from a human point of view, but they are also striking when Technology is viewed within its own limited framework, when we consider the multiplication of its powers.

The discontinuities of technological development are striking in yet another respect. Zvorykin and other writers have demonstrated that when a new technology emerges, its improvement is at first rapid. Then the growth curve reaches a plateau. We have reached the point of diminishing returns. Further improvements are so difficult, time-consuming and costly, and the dividends so small, that progress is really illusory. The study of machines designed for one purpose, such as the steam locomotive, diesel locomotive and turbolocomotive, Zvorykin argues, shows that at first the efficiency of these machines rises quickly. After a while the curve showing the increase of efficiency changes. When the curve approaches the straight line, it means that the potentialities of a given machine are exhausted. It is also an indication of an approaching leap, a switch to a new machine, a new technology or a new process. This can be seen as one of the fundamental features of the technological development.

Among significant discontinuities in the technological development, we should clearly discern one – namely, the new role Technology came to play in the post-Renaissance world: the role of the supreme instrument in controlling nature. This point will be discussed at length during the course of this paper. And this point brings us to the third question.

Does the flourishing of great civilizations and of great art always occur when Technology is most advanced? Yes, if we establish by definition that the flourishing of great civilizations is but a byproduct and a manifestation of technological achievements. Yet, to a discerning eye, this parallelism is by no means obvious. The ancient civilizations of China and Greece – to mention the two spectacular examples – flourished at the time when Technology (in our sense of the term) was held in very low esteem, was indeed disdained. The inventive genius of the Chinese and the Greeks made it possible for them to develop Technology far beyond the scope of its use at the time. There were many discoveries and inventions, but they were never implemented. Thus, there was the germ of Technology, but no fruit; the potential but no actualization. From our point of view this was an irredeemable waste. We cannot truly say that technology flourished in the Classical period of ancient Greece or in ancient China; yet these civilizations did.

The surge forth of Technology is a phenomenon of the modern world. Before Technology could expand triumphantly, we had to acquire a rather special attitude toward nature. Modern Technology is an instrument designed to control nature, to repeat a truism. This instrument could not have evolved, at any rate not in the form it did, before we had conceived the idea of the conquest of nature. Thus, fundamental to the understanding of modern Technology is the understanding of our changing relation to nature. There is an invisible link, but a profound one, between our idea of nature and our idea of Technology. I shall anticipate my subsequent argument by stating now that the expansion of Technology coincides with our idea of nature as a caretaker of our needs and a subject to our will; the second part of this argument is that the periods during which man lives in symbiosis with nature are not the periods when Technology surges forth. With this as a prelude I turn to the state of technology in ancient Greece.

II. The Greek Ideals and Technology.

The first and fundamental question is: Why did Technology not develop in the ancient world? Nobody seems to have a coherent answer. Perhaps the answer should be similar to that which Einstein gave when asked why science did not develop in the Orient. The fact, he said, that science did not develop in the Orient needs no explanation at all, but what does need explanation is that it developed in the first place. Yet it is intriguing that the Greeks, who invented so many gadgets, did not arrive at our idea of Technology as a collection of labor-saving devices, as an instrument for the mastery of the external world. The Greeks were incredibly inventive – and not only the Greeks in the Hellenistic age, which is known for its mechanical inventions mainly because of the genius of Archimedes and Hero of Alexandria, but also the Greeks in the Classical period. We are perfectly well-acquainted with the intellectual and cultural climate of the Golden Age of ancient Athens under Pericles, when Socrates lived; but we are rather ignorant of the fact that all kinds of extraordinary gadgets were employed at that time, some very clever indeed, as, for example, machines designed to mimic human behavior. But it was all for the purpose of entertainment. Hardly any attempt was made to employ these gadgets in the process of, as we would call it today, industrial production. And this fact is very puzzling indeed. Some historians find an explanation in the features of the socio-economic system of Greece at that time. They contend that there was no need for Technology in our sense because slaves were sufficient. Some argue that "the wealthy slave owners did not want labor-saving devices". Others argue that "the plans to harness the forces of nature which the engineers proposed in the handbooks were not supported by public money nor were the scientists or 'philosophers' interested in the efforts of these superior craftsmen". Some of these arguments – for example, that the plans of engineers to harness the forces of nature were ignored – are entirely off the mark, for they assume that the same attitude of conscious attempts to harness the forces of nature which we have seen at work during the last 350 years in the Western world also prevailed in ancient Greece, which it did not.

A much more ingenious explanation is developed by Brumbaugh in his book Ancient Greek Gadgets and Machines. He suggests that the idea of deliberate attempt at invention was alien to the Greeks. They attributed the invention of basic tools and techniques, such as the bellows, anchor or potter's wheel, to some ancient legendary genius, bordering on magic. Basic inventions, being ancient, legendary and almost superhuman, did not seem to belong to the world of presence and of ordinary mortals.

Now, were there some other factors which might have prevented the development of Technology from within, as it were? One of them was certainly the Greek ideal about what kind of life is worthy of a man. Witness in this context Plutarch's opinions about Archimedes and how disparagingly Plutarch talks about Archimedes' inventions:

> Archimedes possessed so high a spirit, so profound a soul, and such treasures of scientific knowledge, that though these inventions had now obtained him the renown of more than human sagacity, he yet would not deign to leave behind him any commentary or writing on such subjects; but repudiating as sordid and ignoble the whole trade of engineering, and every sort of art that lends itself to

> *mere use and profit,* he placed his whole affection and ambition in those purer speculations where there can be no reference to the vulgar needs of life. (Italics H. S.)

Archimedes is said to have constantly apologized for his inventions and justified them as mere amusements, as diversions, as useless toys. Thus, a human being or a citizen, as contrasted with a slave or an animal, was a man who did not sully his hands with manual work, whose art did not lend itself to mere use and profit. In such an intellectual climate, Technology had little chance to develop, not because slaves were sufficient or slave-owners did not want labor-saving devices, but because it was morally and intellectually repulsive. And these moral and intellectual constraints had a great power over the Greek mind.

There is one element which I find constantly missing in various accounts of ancient technology. This element is the attitude toward nature. It is a part of my general thesis that these two elements – the attitude toward technology and the attitude toward nature – are two sides of the same coin. The attitude toward technology in ancient Greece and elsewhere is a corollary of the attitude toward nature.

Around 600 BC the Greeks chased the gods from their universe and attempted to give natural explanations to phenomena which had previously been explained by reference to the intervention of the gods. Perhaps the effort to *comprehend* the workings of nature in non-theosophic terms was great enough; perhaps the Greeks were unable to go a step further toward *controlling* nature. Yet, I believe that this was not the case. It seems that it was not because they lacked the capacity or mental resources that they did not attempt to control nature, but rather because of their basically *symbiotic* relationship with nature. Let me explain this point in some detail. It seems that the Greeks did not separate nature from the rest of their universe clearly enough. This separation was only to happen in modern times. Thus they did not consider nature as object outside, fixed and ready for exploration, independent for its existence from us. Nature, as it were, was too close to them to be objectified. To put it in other words, nature was treated as subject rather than as object. These two different attitudes in treating nature – as object and as subject – must be firmly grasped in order to comprehend Technology during the last few centuries.

Perhaps the clearest evidence that the Greeks did not objectify nature sufficiently lies in the fact that they did not develop the experimental method. They did develop imaginative conjectures and hypotheses about nature. But they were satisfied with the rational power of their conjectures and explanations. They did not test these conjectures and explanations against empirical reality. The concept of nature as something constant, immutable and firmly established out there, against which we test our hypotheses, was not a part of ancient science. This may be very curious and puzzling, but this is what the rationalist tradition meant in ancient Greece. Because of their conception of nature the Greeks could not have developed the idea of empiricism as practised in modern science since Galileo. And this also explains why they could not have conceived the idea of controlling nature and the idea of the conquest of nature.

III. *Medieval Theology and Technology.*

Another hypothesis which we must examine claims that the roots of modern Technology are in the canons of the Judeo-Christian religion. Some thinkers have suggested that the origins of the notion of the exploitation of nature can be found in the Scriptures, in the essentials of the Judeo-Christian tradition. It is contained in the Judeo-Christian mythology, they argue, to think of man as ruthlessly lording over nature, and to think of nature as the object of his will and rule. The basic premise of this argument appears to be that the destruction of the environment was written in the blueprint given to us on Mount Sinai. I shall first present the argument and then will attempt to show that this position is indefensible and indeed fundamentally mistaken.

The view that modern technology is rooted in Judeo-Christian teleology is advocated vigorously even by such eminent historians as Lynn White. He argues that a new system of agriculture in the Middle Ages was an expression of a new attitude toward the soil and thus toward nature. "Man's relation to the soil was profoundly changed. Formerly man had been part of nature; now he was the exploiter of nature. Nowhere else in the world did farmers develop any analogous agricultural implement. Is it coincidence," White asks, "that modern technology, with its ruthlessness toward nature, has so largely been produced by descendants of these peasants of northern Europe?" White continues his argument by suggesting that the new Frankish calendars set the style for the Middle Ages, showing "men coercing the world around them – plowing, harvesting, chopping trees, butchering pigs. Man and nature are two things, and man is master".

These are very interesting arguments. But are they substantial enough? Is plowing really coercing the world? If this is so, then the coercing of nature started to occur at the time when man, the hunter, became man, the farmer. And then Lynn White's argument collapses, because it is not the case that coercing nature started in the Middle Ages. Moreover, is it not the case that the Middle Ages invented rotation farming, thereby emphasizing their care for the soil? Furthermore it seems that Lynn White reads too much into the pictures of the medieval calendars. How much can we really deduce from calendars about people's world views?

Thus, we need much firmer evidence for the view that the aggressive tendencies of modern Technology have their roots in the Judeo-Christian tradition. Can this evidence be found in the Book of Genesis, as some wish to suggest? We read there that man was created in the image of God, Who gave him "dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth." The crucial term here is of course 'dominion'. If this term is to be understood in the sense in which it was used in reference to political empires and dominions, such as the Roman Empire and the British Empire, then dominion is indeed the territory for exploitation and plunder. But there is no reason to suppose that this was the intended meaning of the Scriptures. On the contrary, there is every reason to suppose that this was not the intended meaning of the Scriptures. Why? Because man, systematically destroying his dominion, would be a very poor image of God. Alternatively, it could mean that God had wished to project a very poor image of himself, which again is nonsense. On the third interpretation it follows that if man, created in the image of God, is designed to destroy his dominion, so is God set for the same task, as man only reflects God's intentions. Such an interpretation suggests that God is a malicious monster who created the world for the pleasure of its destruction; which again is an absurd conclusion. Thus the suggestion that the aggressive tendencies of modern Technology have their source in the Judeo-Christian tradition leads to nonsense.

This suggestion is nonsensical for another reason. The doctrines of the church, which were the foundations of the medieval world, are certainly a part of the Judeo-Christian tradition. The conception of the world and of man as embodied in these doctrines stands in explicit opposition to the idea of man as the ruthless exploiter of the earthly kingdom. It is universally known that the ideal of medieval man was not the conquest of nature but of himself; not the mastery over nature but the mortification of his flesh. For the sake of eternal salvation, the external world had to be disregarded, treated as a transient stage full of temptations on the path to eternal glory. And indeed this world was disregarded, pushed to the periphery of human existence, treated as a sinful bondage.

I shall reiterate the point: to medieval man, inspired by the doctrines of the church, nature served no purpose in the overall scheme of salvation; indeed it was a hindrance. In this context, it would make no sense whatsoever to talk about man's expansive drive toward the domination of nature. Nature was a dormant aspect of man's existence, a bondage rather than an element of satisfaction and gratification. This will all change with the discovery of nature in the period of the Renaissance. Before we have a glimpse at this period, let us reflect on some major points.

I have argued so far that fundamental to the exploitation of nature for our own ends is the separation of nature from ourselves. This separation consists in treating nature as a thing outside ourselves, and furthermore as a hostile force which we have to dominate before it dominates us. This idea of estrangement from nature and the assumption of inherent hostility between man and nature is characteristic of the Occidental civilization and of the rational ideology which is the basis of modern Technology. In civilizations in which this separation and polarization have not occurred, the axiom that God gave man dominion over nature may lead to quite opposite results from those we observe in the Western technological civilization. Oriental civilizations, both in the past and in the present, have been based on a far more intimate symbiosis between man and nature than ours. In these civilizations the autonomy of man is perhaps smaller, but the degree of unity of man with nature much greater than in ours. Nature is not the thing-in-itself to be explored and exploited as object, but is a form of universal envelopment; all human experience is enclosed in this form.

Let us consider India, a country of ancient culture and strange religious customs. The sacred cow, well fed and roaming freely amidst famine and starvation, is to us an aberration if not an outrage. It is an experience contrary to our entire frame of mind to see in a temple thousands of rats regularly fed with milk and grain, plump, their fur shining, amidst haggard human beings, underfed and under-clothed, but serenely praying in the same temple. Yet, is it not a manifestation of man's dominion over "every creeping thing that creepeth upon the earth"? Does it not make perfect sense to suggest that man's dominion means not man's slaughter of other creatures, but man's care of them even at his own expense?

A partial conclusion which follows from these arguments is that mechanists and behaviorists of all descriptions seem to be unable to comprehend that what is not required is not further fragmentation of nature, not further division in order to arrive at absolute indivisible components out of which new wholes can be constructed to create a brave new world, but a fundamental re-orientation, a movement away from fragmentation: a restoration of this invisible envelopment which nature has been to us through millenia, the envelopment whose existence we become aware of when it is torn to shreds.

Our arguments so far have attempted to establish one thing, namely, that the understanding of the role and function of Technology in the modern occidental world is inseparably linked with our understanding of nature and its place in the overall scheme of things. With this in mind we shall enter the Renaissance, the period of the discovery of nature, which was a pre-condition for the future exploration and exploitation of nature.

IV. The Discovery of Nature.

When we compare the paintings of the Middle Ages with the paintings of the Renaissance we become immediately aware of the vast difference between the medieval and the Renaissance outlook on nature. For the medieval painter nature hardly existed; the content of the painting was the inward world. This is also true of the great masters who lived in the period of transition from the Middle Ages to the Renaissance, such as Giotto. The Renaissance, as we know, discovered perspective. The discovery, or perhaps we should say the invention, of perspective was necessary for the discovery of nature in a true sense. For the medieval painter, perspective was not essential at all. For the Renaissance painter, on the other hand, so deeply steeped in the external world, perspective was of vital importance. Because of this, it had to be invented.

Turning from the inward world to the outward world had innumerable consequences. One of them was the discovery of nature most eloquently demonstrated by the Renaissance painter. It is inconceivable that Technology would have developed as an instrument for controlling nature without a prior act of the discovery of nature. In the occidental world this act occurred during the Renaissance. Nature became objectified, became an object apart from ourselves: First an object of aesthetic contemplation, then an object of exploration and finally the object of exploitation. In other words, we had to discover nature first in order to be able to rape it later.

Leonardo Da Vinci. Nobody exemplifies the genius of the Renaissance better than Leonardo Da Vinci (1452-1519). He has fascinated an extraordinary range of people from Kant, Marx, Nietzsche, Jaspers, through Jacob Bronowski, Lewis Mumford, Konrad Wachsmann, to the most pedestrian engineers. Leonardo was the embodiment of all the tensions and visions which were to dominate the Western world during the next five centuries. Because he was a single human being, he could neither contain nor resolve these tensions. In particular, he combined in his mind and in his life the three stages through which the European mind was to pass before Technology could become triumphant: the discovery of nature, its exploration, and its exploitation. His relentless pursuits in describing nature, in exploring it, in making inventions which would enable man to transcend nature represent a miniature history along which the European mind was to evolve during the next five centuries.

He was a man immensely steeped in the external reality. Jaspers rightly says that "this reverence for the visible world is what distinguished Leonardo from all ancient and Christian metaphysicians". Jaspers is right again when he suggests that Leonardo's superhuman effort to specialize in everything was doomed to failure. For the truth is that in spite of his stupendous accomplishments, Leonardo was also a dismal failure. He published nothing of his discoveries in his lifetime. We had to rediscover many of his discoveries to appreciate his greatness. Most of his projects and inventions were left unfinished. His contemporaries and many later generations thought of them as crazy and unrealizable. Leonardo died in despair, almost forgotten, embittered and remonstrating himself in the end for indulging in all these "useless" studies. He asks himself in his diary, "Tell me if anything at all was accomplished." Yet we praise and worship him today as one of the most universal minds that ever existed, and as one of the greatest inventors. His tragedy was that this mind was too modern for his times. Not only was he bound to produce miscomprehensions among his contemporaries, but he was also bound to fail for objective reasons: the store of existing knowledge and existing experience at that time was not sufficient to nourish this mind so that it could come to fruition. Leonardo saw the situation in more subjective terms. He deeply resented being ignored by the scholars of his time. "They go about," he sulkily complained, "puffed up and pompous, in fine raiment and bejewelled, not from the fruits of their own labours but from those of others; my own labours they refuse to recognize, they despise me, the inventor, but how much more are they to blame for not being inventors, but trumpeters and reciters of the works of others? They are little indebted to nature, for it is only by chance that they wear clothes that they can be distinguished from herds of animals." As he had no formal education, he attributed some of his failures to the arrogance of the "educated fools", as he called them.

The simple truth is that Leonardo's ideas, regardless of the arrogance and ignorance of the cultured fools, could not have come to fruition before a systematic exploration of nature had taken place. This exploration was to take more than two centuries. And only then the conquest of nature could really start. Bacon's motto, "Knowledge is power", could then be actualized. The three stages which were necessary preconditions for triumphant Technology to emerge were:

(1) The explicit awareness of nature;
(2) The ideal of systematic empirical exploration of nature; and
(3) The quantification of nature.

Leonardo lived only during the first stage, during the period of the discovery of nature, although he attempted to live in the next two as well. In relation to the second stage, Leonardo is to be congratulated on his approach to the scientific method. "Those sciences are vain and full of error which do not terminate in observation," he maintained. Note that this is not the Baconian ideal of *starting* from observation, but a much more sophisticated one of *terminating* in observation.

At the time he was painting "The Battle of Anghiari" (one of his failures), Leonardo was working on a four-volume treatise concerning the flight of birds, and also secretly constructing a flying-machine, this time infallible, which was going to redeem all his previous unsuccessful attempts. Alas! The flying machine had to wait. And so had other numerous inventions. Neither science nor technology were ready to furnish Leonardo with the necessary tools. It took another century before the programme of the empirical investigation of nature fully crystallized. This was the century of tumultuous ferment and vehement criticism of medieval and ancient authorities.

Francis Bacon. Sixteenth century science worked with the axiom that no authority whatsoever should be obeyed, that only the actual unbiased investigation of nature can provide genuine knowledge. No one exemplifies the spirit of the new science better than Francis Bacon (1561-1626). He was the most articulate spokesman for the new science, although alas not its most successful practitioner. Bacon was a prophet of the experimental method in science. We must purge our minds, he urged, of all the prejudices, refine and purify it; and then in the state of intellectual nirvana we shall be ready for the communion with Facts. Uncontaminated facts, shining out there in nature, will reveal their truth to the uncontaminated mind, and this will be the basis of genuine knowledge. The conception of the unbiased investigation of nature was of course right. The conception of the mind entirely purified of all the prejudices and preconceived notions was of course wrong. What is important in Bacon are not the details but the general conception of the experimental method. But still more important was Bacon's overall ideal of knowledge. KNOWLEDGE IS POWER, he announced at the end of the 16th century. The Baconian programme became a dominant characteristic of the Western intellectual tradition during the last three centuries.

Bacon's succinct motto is enormously important for another reason. In it there are the roots of modern Technology. We need to change only one word in order to obtain a perfect description and justification of modern Technology. Instead of saying "Knowledge is power", Bacon should have said "Technology is power". Then the overall Baconian programme perfectly fits the development of Western society during the last three centuries and the last century especially.

Modern Technology, I have argued, consists not only of tools, but also of the ideology regarding the purposes these tools are used for, and also regarding the concept of man in the universe. The ideology for the expansive drive of modern Technology was provided by Bacon. He wrote: "Man, if we look for final causes, may be regarded as the centre of the world, insomuch that if man were taken away from the world, the rest would seem to be led astray, without aim or purpose... For the whole world works together in the service of man; and there is nothing from which he does not derive use and fruit... insomuch that all things seem to be going about man's business and not their own." This is a bold and assertive programme. Here is *raison d'etre* of our technological invasion of nature.

Thus, one of the most important of Bacon's endeavours was the shift of our vision from knowledge conceived exclusively as the source of enlightenment, the Greek ideal, to knowledge conceived as the source of our domination over nature, the ideal of the modern occidental mind. We should not overlook the fact, however, that Bacon was not a crude pragmatist; he did cherish knowledge for the sake of enlightenment in the truly Greek fashion, but in addition to this ideal, he conceived of knowledge as the instrument of power. Obstacles to knowledge were to be removed, and new strategies for the acquisition of knowledge were to be designed in order to make this knowledge useful, instrumental, powerful. In this scheme, the value and utility of the knowledge of the ancients, Bacon beautifully argues, is of no avail: "The wisdom which we have derived principally from the Greeks is but like the boyhood of knowledge and has the characteristic property of boys: it can talk but it cannot generate, for it is fruitful of controversies but barren of works." As all ideologies, Bacon's programme served many purposes. One of them was the liberation of man from the hermetic castles of medieval theology.

Now, what makes Bacon so important as the prophet of modern Technology is his vision of knowledge as power, a conception almost alien to the Greek mind. However, the implementation of Bacon's programme was not possible without further explorations of nature and in particular without the quantification of nature.

V. *The Quantification of Nature.*

It was Galileo Galilei (1564-1642) who conceived the programme of the quantification of nature. In a famous passage on the language in which the book of nature is written, he said, "Philosophy (which at that time meant science, too) is written in this grand book, the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics... without which it is humanly impossible to understand a single word of it; without these one wanders about in a dark labyrinth". This programme was followed for the next three centuries of scientific development.

Galileo's mathematical vision of the world, it might be argued, contains nothing new. After all, it was the Pythagorean conception of the mathematical harmony, of the number, that holds sway over the flux. The similarity is striking, but only up to a point. For while Pythagoras was a mystic, Galileo was an empiricist; while Pythagoras' mathematical approach to the world was blended with mysticism, Galileo's mathematical approach was blended with empiricism. It was the empirical world discovered by the Renaissance which Galileo was exploring mathematically.

But mathematics was only an instrument for the formulation of results. Mathematics alone could not be a method for the acquisition of new knowledge. The actual method of acquiring knowledge was experimental: empirical testing of the consequences of hypotheses by means of which we try to grasp the world around us. The basic difference between Bacon's experimental method and Galileo's experimental method is that whereas Bacon urges us to *start with facts and experiments and to induce theories from them*, Galileo insists that we must *start with imaginative hypotheses and only at the end subject them to empirical tests*. Imagination can and must violate common sense. "I cannot find bounds for my admiration", Galileo wrote, "how the reason of Aristarchus and Copernicus has committed such a rape upon their sense as despite them to make herself mistress of their belief". Similar eulogies about the value of imagination can be heard three centuries later from Einstein: "Imagination is more important than knowledge. Knowledge is limited, imagination embraces the world, stimulating progress, giving birth to evolution". Now, we must be perfectly aware that it was the Galilean conception of science that has finally triumphed, not the Baconian. But we must also be aware that the clouds of the Baconian conception are still shrouding the minds of many people.

The supreme architect who executed the design for the quantification of nature was Isaac Newton (1647-1727). Newton followed Galileo's programme to the letter. But it took quite a few decades before the first alphabet for reading the book of nature was provided in Newton's *Philosophiae Naturalis Principia Mathematica* (*Mathematical Principles of Natural Philosophy*, 1687). It took yet another century after Newton's *Principia* appeared before the mechanistic model of the universe as based on Newtonian mechanics finally emerged. The universe came to be viewed as a huge, but perfectly working clock whose laws are not only discoverable but discovered. All explanations, to be considered genuine, had to be mechanistic explanations or reducible to mechanistic ones. Now the quantification of nature was accomplished. Whatever was not quantifiable was considered either non-existent or unimportant. It was at that time that science completed its task for Technology, and Technology was ready to start its conquest and subjugation of nature not only in theory but in practice.

To summarize our story so far. The collapse of the hierarchical, closed, theologically-centered system of medieval thought in the period of the Renaissance led to the crystallization of a new attitude toward man, toward the universe and toward nature. This new attitude is perhaps best expressed in Bacon's motto, "Knowledge is power", which meant power to conquer and subordinate nature, power to change our environment. This further gave rise to our concept of progress as based on the idea of changing the environment to suit our needs. Galileo's programme of the quantification of nature and Newton's spectacular achievements in fulfilling this programme, together with the 18th-century additions and extensions of it, combined with the mechanistic model of the universe that emerged at that time, provided an efficient matrix for extricating the secrets of nature and also provided a basis for modern Technology, which became the most ruthless instrument in our conquest of nature. From the middle of the 19th century, after science perforce married technology to become technology's servant, the change of our environment has been rapid. In the 20th century our environment ceased to be the constant that it was for millenia; instead it became a variable, a function of technological change. The ecological crisis began exactly at the point when environment from a constant became a variable.

We have reconstructed this story in order to show the intricacy and complexity of the process which led to the development of modern Technology. This process contained a number of preconditions which had to be fulfilled before Technology could acquire its full potential. In realizing these conditions, we have acquired certain dispositions and attitudes, we have acquired in other words a certain frame of mind, which is known as the rational modern European mind. We can now say that Technology is not only and not so much a collection of tools and machines, as a state of Western mentality. Heidegger's declaration that Technology is the last stage of metaphysics becomes meaningful in this context. Our inability to come to terms with Technology is directly related to our infantile naivete about the nature of Technology. We still assume that Technology and our world view are two different things; we still assume that Technology is "indifferent", that it contains no metaphysics, and that its relation to traditional metaphysics is none. All these assumptions are an expression of an infantile mind.

Technology, as we know it today, is an historical phenomenon born of a certain idea of nature, of a certain idea of progress, of a certain preconception about the deterministic structure of the world and of certain specific social ideals and specific visions of the ends of human life. As such, it is laden with the elements of traditional metaphysics. Now, since Technology is an historical phenomenon born in a certain historical situation, there is nothing absolute in it. But because it is a phenomenon which evolved through history, we must not think that it will be easy to change the existing course of Technology, for it embodies a few centuries of a cultural, social and intellectual tradition, the tradition which has permeated the recesses of our mind and the structure of our mentality. Technology is now a part of our world view.

VI. The Utopian Heritage.

So far we have discussed mainly the intellectual and scientific components which were prerequisite for the emergence of modern Technology. In addition to these cognitive factors, we must consider the social ideals whose influence has been profound but much less tangible. These ideals were embodied in the great utopias of the Renaissance and post-Renaissance period. When the religious structures which justified man's craving for the transcendent were punctured, secular structures offering man new transcendental goals had to be invented. It is at this point that the idea of progress was born. The concept of progress as a secular category thus replaced the old concept of progress which was a religious and spiritual category. We have secularized our goals but they were still the goals beyond our immediate reach; in this sense they were transcendental goals. Thus, we can easily see that the powerful sway of utopian thinking pervades the development of modern science and modern Technology. We simply delude ourselves if we think that this development was rational through and through, free from mythology and free from utopian thinking.

There is no escape from utopia. There is only a choice between those utopias which dwarf and suppress us as individuals and as societies and those which liberate and emancipate us from the bondage of our natural and acquired limitations. Every utopia is a programme for liberation. And so were the social utopias of the Renaissance and post-Renaissance times, now built into the foundations of science and Technology. They were conceived as programmes for the liberation of man from the tyranny of religious dogmas, and also and perhaps above all from the tyranny of the elements of nature. Bacon's programme, "knowledge is power", was indeed an extension of his utopia. The French Encyclopedists of the 18th century were no doubt Bacon's disciples. The monumental 35-volume *Encyclopaedia* they left behind carried out with utmost faithfulness Bacon's programme of cataloguing all useful knowledge, and it was inspired by the same desire to perpetuate progress. The emphasis was thus laid on *useful* knowledge. Although in one sense a great achievement, in another the *Encyclopaedia* was a failure. It meant to be the ultimate catalogue of practical knowledge, the foundation upon which the prosperity of the individual and the well-being of societies would rest. The ultimate useful knowledge which the Encyclopedists proposed to assemble turned out to be very preliminary. We do not consult the Encyclopaedia nowadays if we really want to learn about the furthest extensions of useful knowledge. In this sense the *Encyclopaedia* was a failure. But in perpetuating the myth of progress, the influence of the *Encyclopaedia* and of the Encyclopedists was unrivalled.

Rousseau and the First Revolt against Progress. The 18th century, as we all know, was not only the epoch of the French Encyclopedists, but also of Rousseau. Jean-Jacques Rousseau (1712-1778) represents the first revolt against the ideology of modern science and Technology. This revolt was carried on under the banner: "Down with civilization!" Civilization for Rousseau was tantamount to the evil force which deprives us of freedom and thus of humanity. When we examine the notion of civilization as conceived by Rousseau, we realize at once that Rousseau fought against the programme of liberation as formulated by Bacon and the Encyclopedists and as based on the idea of progress. But Rousseau's was also a programme of liberation. Man is born free and yet wherever we look we see him in chains, Rousseau emphatically announces. Thus, we witness here the clash of two programmes of the liberation of man from the tyranny of extrinsic forces. The extraordinary thing is that Rousseau wanted to liberate us from what had been previously conceived as a form of liberation from some *other* constraints and tyrannies.

Rousseau effectively argued that civilization has imposed on us *artificial* needs. The pursuit of these needs has alienated man from his essence, deprived him of his humanity. The tyranny of artificial needs is the greatest malady of mankind because it has fundamentally impoverished the individual life of man. This diagnosis is of course alarmingly contemporary. Rousseau was absolutely prophetic in analysing the predicament of the 20th-century technological society.

How can we regain our lost humanity? asks Rousseau. This question is even more relevant today than it was in Rousseau's times. In many ways, therefore, Rousseau is our contemporary. Rousseau's solution was the doctrine of individual salvation. For Rousseau was the first hippie. Civilization and the artificial needs it imposes upon us must be defied by opting out from society and civilization. Man must return to nature, thus to himself, thus to his essence through the individual act of defiance. Not a rebellion against the social system but rather a liberation from the web of artificial needs and phony relationships can put to an end the slavery of the individual in the machinery of civilization. This is a classical hippie solution. The hippies have a great and outspoken predecessor in Jean-Jacques Rousseau.

Essential to Rousseau's new philosophy was his new conception of nature. Nature was treated by Rousseau not as object, but as subject; in other words, not as object for exploration in order to satisfy man's material needs, but rather as a part of his spirituality, as a primordial state of harmony which we must reach in order to regain humanity. Nature is thus for Rousseau an imaginary matrix, the ideal where the symbiosis of the individual with the outside world and with his inner essence takes place. Rousseau's solution to combat the alienation caused by artificial needs is, to say it once more, individual. He does not advocate a reform of society through which we shall be liberated, but he advocates rather the personal act of defiance, the individual return to nature.

Marx – A Revolt Against Progress in the Name of Progress. A century later another powerful voice protested against the suppression of the individual and the deprivation of human dignity by the all-enveloping system of expanding Technology. This was the voice of Karl Marx (1818-1883). I am referring here specifically to the philosophical views of the young Marx, particularly as expressed in the *Economic and Philosophical Manuscripts of*

1884. There is no question that Marx's primary concern was the liberation of the individual, of the human being from the tyranny of objectified relationships which he inadvertently imposed on himself. Thus Marx's is a Rousseau-like programme of the liberation of Man from the constraints and tyrannies of the external world. But Marx saw these constraints and tyrannies through the spectacles of a moralist who witnessed the effects of the industrial revolution. The process of alienation, another name for which is dehumanization or the estrangement of man from his essence, is the process of objectification, the process during which man, the human being, becomes an object. In Rousseau's times this estrangement occurred through the submission to artificial needs (as Rousseau calls them). In Marx's time the main form of this "objectification", of turning the subject into the object, was alienation through labor, through the relationships occurring during the process of production, through the buying and selling of human labor. This was the negative aspect of the otherwise rational, secular and scientific world in which Marx believed so passionately. He set himself to rectify this aspect in his own way.

Marx's attitude toward Technology is rather complex. But there is no question that he saw in expanding Technology a necessary condition of the liberation of man. The subordination and control of nature was a necessary condition for Technology, which can liberate man. Thus nature was treated by Marx as object. Man must first liberate himself from the constraints of the natural elements and then ultimately will liberate himself from Technology. The most important task for his own time Marx saw as the liberation of man from the tyranny of the machine, which was the result of the unfortunate social system. The reformation of society was the necessary condition for the return of man to himself, to his essence, to his lost humanity. The evils of Technology are due to the structure of society. We must change this structure in order to enable Technology to bring about the liberation of man.

Although Marx was intellectually independent in many ways, he was profoundly indebted to Rousseau in his conception of man, not only implicitly, but in the very terminology he used to defend the dignity of man. But there is one fundamental difference between Rousseau and Marx. Whereas Rousseau's programme of reform was *individual* and consisted of opting out from civilization and society, Marx's programme, on the other hand, was *social* and consisted in calling for a collective effort to change the structure of society. Thus we witness here two basic types of possible remedies against the suppression of the individual human being by objects and relationships he has inadvertently developed, Rousseauian – individual, and Marxian – social. Both have been tried. Both have failed.

The problem of alienation haunts us now more than ever before. We are at the mercy of the increasing quantity of objects which saturate and atomize our human environment, which constantly require our attention, and which condition us to ever new and often artificial needs. According to the original conception, spelled out in many utopias, technologies were to be invented to gratify our genuine needs. Now we have reversed the formula and indeed perverted it: needs are artificially created to satisfy the demands of Technology. Take, for example, ever-more-powerful motor cars whose power is never utilized, or take electric toothbrushes and other idiotic gadgets. And this is by no means a trivial problem. We craved to be saved *by* Technology; now we crave to be saved *from* Technology.

Where shall we turn for a possible solution? As we have said, there is the individual solution, as exemplified by Rousseau and the hippies. And there is the social solution, as exemplified by Marx and the revolutionary students. Neither sheer escapism, as in the case of the hippies, nor anarchistic revolution, as in the case of militant students, will carry the day. The dearth of constructive programmes among revolutionary students and the hippies renders their negations an act of despair, not a genuine rebellion.

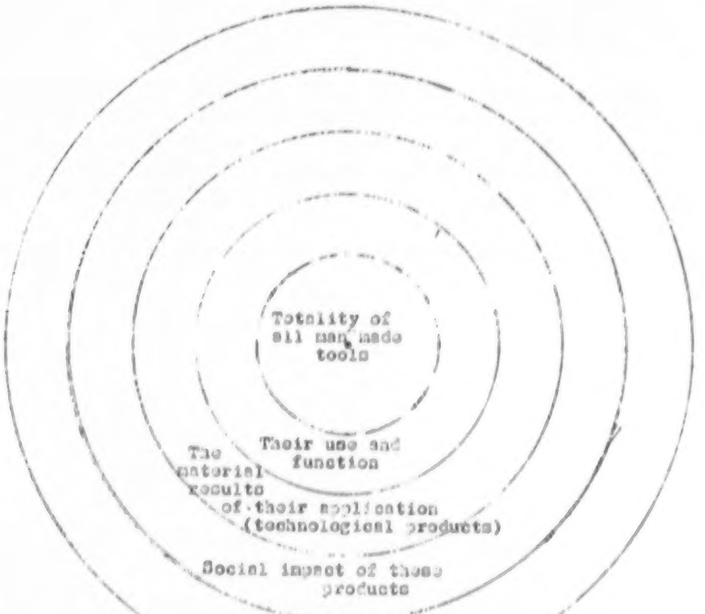
Can there be a third solution? At first sight it does not seem so. Yet, when we analyze the situation with some care, the third solution can be discerned. Now, Rousseau suggested an individual solution; and he treated nature as subject. Marx suggested a social solution; and he treated nature as object. Thus we can distinguish two different approaches and two different conceptions of nature. What I am going to suggest as the third possibility, one that has not yet been tried in the modern occidental world, is combining the treatment of Technology as subject with the social approach. The few remarks I can offer here do not pretend to provide a programme. What is, then, a possible third solution? We must work toward a new social utopia. Buckminster Fuller summarized this succinctly in a phrase which is the title of his new book: *Utopia or Oblivion.* In this utopia we must treat nature as subject, as a part of ourselves, as a part of our outer skin which cannot be damaged without causing damage to ourselves. This may require a development of a religious reverence of nature, characteristic of some Renaissance painters and of some oriental societies. And this will also require a change in our social institutions and social relationships, which for the time being are set in the opposite direction – toward further growth of Technology for the sake of personal profit, and at the expense of whoever and whatever is in the way. If this reverence for nature becomes a new imperative, then Technology will become harmless. Whether this programme (the third solution) can be implemented in a cold, rational way, we cannot tell; more likely it will require a sort of religious inspiration and fervor which are characteristic of new departures in human thought.

Let us review possible solutions to the problem of Technology in one short table. We have two approaches: individual and social; and two conceptions of nature: as object and as subject.

	Treatment of nature	
Approach	as object	as subject
Individual		Rousseau
Social	Marx	The third Solution

The first rubric is empty; it could possibly be occupied by Francis Bacon.

Summary. As the summary of the whole discussion I shall present five conceptions of Technology; each broader than the other. Each will be represented by a circle, and every broader conception will include the former, narrower one. So we shall have five concentric circles. The first innermost circle, which represents the narrowest conception of Technology, is identified with: (i) The totality of all man-made tools. The second circle represents: (ii) Their use and function (of course it contains in itself the first circle). The third circle represents: (iii) The material products resulting from the application of the tools and of the knowledge of their function (motor cars are products of certain tools and the knowledge of their function). The fourth circle represents: (iv) Social impact of the products listed in (iii); of course it includes all the previously-analyzed circles. And the fifth circle represents: (v) The influence of technological change on the lives of particular individuals. Now all these conceptions can be presented by means of a diagram:


Totality of all man made tools
Their use and function
The material results of their application (technological products)
Social impact of these products
The influence of technological change on the life of particular individuals

It is painfully obvious that when we discuss the problem of Technology, the impact of Technology on society, the roots of our present crises, we are not interested in narrow conceptions of Technology as represented by (i), (ii) or (iii), but we are interested precisely in the broad conceptions of Technology. Whoever argues that Technology is "indifferent", referring to conceptions (i) or (ii), must be oblivious of the fact that these are trivial conceptions of Technology for which we have little use in social discourse about the nature of Technology. It must be emphasized again that in the modern occidental world, Technology, being a part of our rational ideology, has, more often than not, been conceived in the broad context, as an instrument of social progress, as the means of individual prosperity and happiness; thus it was invariably regarded within the scopes outlined by our circles (iv) and (v).

Now, over and above these conceptions of Technology are the social ideals and social utopias which are in the background and therefore invisible, but nevertheless powerful. They determine the course of the development of Technology. Only a simpleton, such as McLuhan, can think that once we have rewired our minds, once we start to think "electronically", everything will be well and good. As it was difficult for the Greeks to think about their technical inventions in terms of their utility, so it is difficult for us, and will be for a long time, not to think about technology as power, not to think about nature as an object of exploitation.

Technology is a part of our intellectual heritage; it is a component of our view of man and of society. We cannot redirect its course by assuming, as is too often done, that Technology is a huge chariot which will move whichever way we guide it. Technology is not a chariot and what we need is not a more skillful charioteer. Indeed, Technologists are the least suitable people for redirecting the course of Technology, because their thinking has been more corrupted by the concept of Technology as Power than has the thinking of other people.

What we must do is to shift our vision in a fundamental way. From the ideology of modern science, from the further quantification of nature, and from modes of life directed toward further multiplication of material goods (which will further atomize and mutilate the texture of our human and social life), we have to move to a new model for a symbiosis between man and nature, we have to evolve humanized social models based on qualitative, not quantitative, criteria. The return of man to nature will be the return of man to himself; the restitution of the basic qualities of life will be at the same time the restitution of our symbiotic relationship with nature. Once this new vision becomes a reality, becomes the defining characteristic of man's new horizons, we shall have to draw, relentlessly and unhesitatingly, the consequences which follow from it regarding changes in our economic and social structures. It should be crystal clear that this new vision cannot be maintained unless specific and appropriate changes are made in the social and economic structures of our society.

If we are to survive as a humane and human society, a humanistic technology must emerge. To develop this humanistic technology will require an intellectual effort in rethinking all our relationships to nature and to the concept of the human being on a scale comparable to that which occurred at the transition from the Middle Ages to the Renaissance. We are only at the beginning of this process of rethinking.

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Innovations in the Florida schools—elementary school industrial arts

Arthur J. Rosser and Alfred B. Howard

"Innovation" as defined by Webster is "the introduction of something new". Is elementary industrial arts in the Florida schools something new? This question can be answered both ways: Yes and no.

Let's take a look at the "yes" answer to the question first. I say "yes" because there is no formal, statewide-in-operation program. There are several of Florida's 67 counties which have beginnings. These include Lee (Ft. Myers), Broward (Ft. Lauderdale), Alachua (Gainesville), Leon (Tallahassee) and Brevard (Cape Kennedy). Some of these programs are experimental pieces of action research, while others are backed by funds (such as EIE) and in-service education courses.

You may wonder why Florida would try to inculcate the elementary school curriculum with elementary industrial arts. There are several reasons. First, the State of Florida is going through educational change. Some of the new "buzz words" in Florida are "middle schools" and "single-concept films". Second, the new proposed state accreditation standards, for the first time, contain a section pertaining to elementary school industrial arts. As we all know there are elementary school programs existing in other states such as California, North Carolina, Ohio, New York, Illinois, Georgia and New Jersey. (3)

In the new proposed state standards for industrial arts for the elementary school one finds the following definition:

> Elementary school industrial arts is that phase of the elementary school curriculum which provides the child with opportunities for exploration, manipulation, experimentation and planning using tools, materials and techniques appropriate to converting these materals to serve some useful purpose. The instructional program includes construction activities and experiences related to the elementary school subject matter content and to industry and occupations. (2)

This definition leads the elementary teacher or the industrial arts specialist to the challenging task of developing a program for the elementary school. The goals also presented in the standards help to structure the task of selecting these activities. The goals are five: First, the elementary school industrial arts program should motivate, enrich, reinforce and increase learning through the manipulation of tools, materials and activities closely related to the basic elementary subjects. Second, industrial arts should help the student to understand the place of tools in contemporary society and the history of man. The third goal is to develop and demonstrate self-expression, creativity, problem solving and successful accomplishment through the construction of useful things. Fourth, the elementary industrial arts program should help to develop positive attitudes toward work and an understanding of the world of work and occupations. Finally, the elementary program should help to develop safety values and habits through the use of tools and cooperation with other pupils. (2)

These goals offer a great challenge to the elementary teacher who is not skilled in industrial arts, to the industrial arts teacher who is unaware of the capabilities of an elementary school child and of course to the supervisors, both elementary and industrial arts, who must also accept the challenge.

The State of Florida's Interim Bulletin for Industrial Arts outlines in its rationale that the elementary program should have six purposes in serving the K-6 child. It should be used for reinforcement, enrichment, motivation, manual dexterity development, reaching desired outcomes in learning activities and for providing a basis for understanding and appreciating the technological heritage of our culture. These purposes are necessary to satisfy the needs of the 5-12-year-old child. This child has a natural curiosity about the things in his environment. This not only includes materials but also the products and services which are a large part of industry. This child also delights in handling the objects of his environment. He finds it fascinating to hold a piece of coal in one hand and a piece of coke in the other. These materials are similar yet very different. This child also possesses an eagerness to understand the "how" and "why" of materials and processes. (1) How are baseball bats made? How are pencils made? What happened to the holes in the doughnut? Why does a saw cut? Why does glue stick? Why won't an auger bit fit in an electric hand drill chuck?

Let's look at the "no" answer to this question of whether elementary industrial arts is something new in Florida. There are a lot of teachers in the elementary schools of Florida who have industrial arts activities which reinforce, motivate, enrich and all the other things, but they do not realize it. The second grade teacher who has her class make apple butter is using the "arts of industry", and the fourth grade teacher who makes cups and saucers with his "art" clay is also portraying a facet of industrial technology. Many elementary teachers also take their classes on field trips in the name of science and social studies. They visit such industries as power plants, newspapers, dairies, bakeries and automobile assembly plants. All of these activities should be incorporated into an effective elementary industrial arts program which could be used to enrich the existing elementary curriculum.

Now that we have looked at both possible answers to the original question "Is elementary industrial arts in Florida something new?", let's see what is yet to be done. At present there are no requirements for certifying elementary school teachers in elementary industrial arts. There are no full-time working programs; however, there are many in the developmental process.

The next step in the State of Florida is the motivation and indoctrination of teachers, administrators and others in regard to the need for, the place of, and the purpose of elementary school industrial arts. This step has been initiated by Florida State University through its state-wide in-service education program, its workshops and re-vitalizing of its own pre-service courses in elementary school industrial arts. At the present time, Florida State University is the only higher education institution in the State of Florida prepared to serve the public schools of Florida in this area. If innovation is to take place successfully in the area of elementary school industrial arts, it will be due to the combined efforts of Florida State University, the Florida Department of Education, and the schools of Florida.

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Elementary industrial arts to make learning more relevant and lasting

B. Stephen Johnson

Last year at the AIAA Convention I had for the topic, "Organizing a Task Force for Developing a National Curriculum in the Technologies for the Elementary Grades". I feel that through the efforts of the ACESIA, many of the things which were discussed at this meeting were implemented. I feel that this effort should continue to an ever-increasing degree if we believe that learning should be relevant to the child's needs and to our society today and in the future.

I would like to commend the American Council for Elementary School Industrial Arts for their efforts.

It has been evident to me for many years that the majority of the industrial arts teachers have been interested in the education of the total child and that industrial arts can play a major role in the development of the child. However, it seems that only in a few instances have we been able to convince educators that through industrial arts, learning could be more lasting and relevant to a child's needs.

Industrial arts at the pre-school level should include process-oriented rather than product-oriented experiences. This we feel allows for self-selection, self-direction and self-evaluation. It becomes an individualized experience, whereby children at various developmental and intellectual levels work side by side in this environmental situation, with a great measure of success. Each student is allowed to work at his own developmental level and proceed at his own rate and speed.

In the 1-6 grades we in Broward County have provided two types of facilities. A central lab under the industrial arts specialist, trained to teach at the elementary level, is located conveniently to classroom and the resource center. This room provides equipment for teaching the major areas of industrial arts with storage for materials and supplies.

Other elementary facilities, the newest, provide a related arts and science facility. In this open area, activities in art, science and industrial arts can occur. Perhaps this at the present is the most accepted plan, as the availability of specialized industrial arts teachers at the elementary level is so limited. Along with this we have proposed that two floating teachers work with the teachers in nine new open-concept schools. Last month Broward County completed its first in-service training program for industrial arts where the elementary teachers in the county participated. We are hoping through this type of in-service training program that regularly certified elementary teachers will be able to make their programs more relevant to the student through industrial arts activities which can reinforce the child's academic learning. This past year the industrial arts teachers in Broward County developed guides written in performance objectives for a K-12 program. In the elementary program the objectives are written to include the areas of communication, energy, manufacturing, transportation and marketing.

In my observation from a supervisor's position, I would recommend that all of us become active in the ACESIA and that a continued effort be made to involve other disciplines at the local, state and national level in the need for industrial arts at all levels of instruction.

I should like to recommend further that we make every effort to continue the progress in:

(1) Establishing a national level curriculum study committee to develop a K through 12 grade industrial arts curriculum. This should involve persons from other disciplines and other national organizations.

(2) A continued effort in the writing of elementary industrial arts programs, with a sequence K-12.

(3) A continued effort to establish industrial arts programs for elementary teachers – with a requirement of minimum number of hours in industrial arts for graduation. Along with this, I would encourage continued efforts toward elementary certification and a graduate major in elementary industrial arts.

(4) Providing continued in-service training programs in elementary industrial arts, locally and nationally.

(Following these remarks was the presentation of a film, "Woodworking in the Kindergarten", developed by the Board of Public Instruction of Broward County, Division of Instruction, Fort Lauderdale, Florida.)

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Industrial arts at the McDonald Comprehensive Elementary School

Donald C. Hoffmann

In July of 1966 the Centennial School District received an ESEA Title III operational grant in the amount of $432,000.00 for the construction and development of a supplementary learning center called the special experience room. This center was part of the new

McDonald Comprehensive Elementary School that was built during 1967 and 1968. A second ESEA Title III grant, "A Design for Curriculum Research, Development and Evaluation" in the amount of $114,425.00 received in 1967, provided for staffing the special experience room and one specialist in the IA Center. This grant also provided $8,000.00 for equipping the IA Center. District funds in the amount of $2,000.00 provided supplies for 1968-69 school year, the first year of operation. The Federal funding accounted for the full cost of operation during 1967-68 with district funds paying 1/2 of the cost in 1968-69 and most of the cost during 1969-70.

Prior to the construction of the building, several Centennial School District administrators, consulting with leaders in education, developed a plan for a comprehensive elementary school. The school consists of forty classrooms, one of which is the IA Center. The elementary school program revolves around three main learning centers – the library, the auditorium-gymnasium, and the special experience room (SER), where sensory experiences form the core of the curriculum. Each of these centers is the nucleus of the three classroom buildings that are joined by ramps and corridors in a way that facilitates interaction between classes and use of all areas of the school.

The plan provides for the total mobility of each pupil from one area to another. Such movement is dependent upon the pupil's individual ability, aptitudes, needs, interests and his own educational growth and development.

Presently the school houses forty-one classes totaling 935 children. The following organization shows the types of children and number of grades at each level.

7 county classes	(3 retarded-trainable (2 physically handicapped (2 learning disabilities
district classes	8 retarded-educable 10 gifted - 3-4th; 3-5th; 4-6th.
regular classes	2-Kdg; 3-1st; 2-2nd; 3-3rd; 2-4th; 2-5th; 2-6th.

The Philosophy of Elementary Industrial Arts in the Centennial School District

> The teacher's job, his professional responsibility, is to provide richness of experience. The test of good teaching does not consist alone of changed behavior on the part of students. Good teaching is recognized, in part, by the quality of the experiences which are going on in the school.
>
> Louis E. Raths

"To provide a richness of experience" is the primary focus of industrial arts at the McDonald School. The Industrial Arts Center is considered a laboratory where students are given an opportunity to explore and experiment with the technological and esthetic aspects of their experiences in the classroom. An area in the elementary school where individuals and groups of students can engage in three-dimensional problem solving and creative expression supports Jerome Bruner's process approach to education. The interrelationships among the various materials, processes and crafts in every phase of industrial production can be adapted to the endeavors of the elementary school student. We view education as different from skill acquisition: It should be dedicated to skill using, ultimately interrelating the higher levels of the cognitive, affective and psycho-motor domains. Toward this end the industrial arts program is a meaningful component in the elementary curriculum.

Children learn in a variety of ways. The Elementary Industrial Arts Center provides an additional learning environment for the learner to practice and integrate his knowledge toward personally unique and tangible goals.

As the Industrial Arts Laboratory becomes recognized as an essential vehicle of personalized learning, it will become obvious that it is an area where the intellectual, the esthetic and functional dimensions of our environment can result in a rich blend of experiences for the student.

The following objectives are fulfilled in a variety of ways with each child having had contributing experiences in grades K through 6:

The child will experience historical processes that have contributed to the development of our technology.

The child will experience a variety of current industrial methods including the line production technique, use of jigs and fixtures, and the interchangeability of parts.

The child will develop a critical and questioning attitude toward the quality of architecture, textiles, furniture, etc., within his environment.

The child will value craftsmanship, strive to improve his own craftsmanship abilities and develop a sensitivity to the craftsmanship displayed by others.

The child will seek unique personal solutions to problems relating to industrial arts.

The child will develop an affection for materials and a respect for tools and machines.

The child will experience a variety of craft activities.

The child will develop meaningful perception of form, space, light, color, texture and other important human insight.

The child will develop skill in using tools.

The child will explore and experience works produced by contemporary scientists-engineers-artists.

The child will be aware of the role of the industrial artist in our technologically-oriented society.

The child will develop respect for material and natural resources.

The Industrial Arts Center was designed to fulfill two distinct but related functions. The first was to provide a facility for the development of an elementary industrial arts program. The second was to act as a supportive facility for the special experience room. Special effect projectors and other electro-mechanical devices are designed and constructed in the IA Center for use with the planetarium instrument (Spitz STP) and installed in the SER.

The Industrial Arts Center is housed in an ordinary classroom of approximately 850 sq. ft. that was specially wired for power equipment. The center was designed to enable children to work with the following materials: plastics-acrylics, co-polymers, polyesters, wood, metals, tri-wall cardboard, styrofoam, cement, paper, graphics-letterpress, block and silk screen printing, textiles – weaving and sewing – and ceramics. Not all the power equipment available is used by children but is necessary for material preparation which is done by the IA Specialist.

The approach presently taken in this Project is not based on teaching a predetermined body of knowledge that children are expected to master. The children come into the IA Center by appointment and spontaneously (since there are no scheduled classes) to work on problems that are meaningful to them and are related to activities in their regular classroom. The IA Specialist serves as a resource person – as a consultant – to the children for working out solutions to their own questions. The children can learn the proper use of equipment from the IA Specialist and draw on other resource material available in the Center or the school.

Most of the children come into the situation without the skills and knowledge of tools, materials and processes necessary to realize a solution of their problem. It becomes essential that the IA Specialist then help the child develop the required degree of proficiency needed to pursue his objective. The information and skills taught, however, are always related to the child's problem. Learning of specific skills is necessary to solve the problem: When the child becomes competent enough, he continues with his task. He may eventually encounter other aspects which require further specific instruction. A cyclical type of process evolves whereby the child participates in the planning, skill mastery, decision making, and construction or exploration while focusing on a particular industrial arts activity. This approach could be called three-dimensional problem solving.

Problems that are to be solved in the IA Center usually originate in the classroom where the usual subjects are being studied. The activities that grow out of the original problem are not confined to the IA Center but are carried out in the classroom or in both areas simultaneously. The type of activity determines the area used.

The industrial arts specialist is available for consultation and assistance to teachers in any of the nine other elementary schools in the district. Either the I.A. Specialist visits the other school or the children are bussed to the McDonald School, depending on the nature of the activity planned.

Industrial arts experiences assume various forms and culminate in many ways; however, they could all be listed in one or a combination of the following categories:

(1) Project construction in large and small groups or by an individual child.
(2) Line production experience.
(3) Research and experimentation.
(4) Exploration of processes and or materials.

(5) Free creative expression.

Work done by children in the IA Center is ultimately evaluated by the classroom teacher. During the problem-solving process the child evaluates his or her own work with the help of the IA Specialist. The degree of success he experiences is a constant indication of his progress. The IA Specialist frequently meets with teachers to discuss progress of children involved in IA activities.

During the 1968-69 school year a brief survey showed that over 500 of the 850 children in the school had been involved in the IA Center at least once. This year approximately 40% of the children attending the school have been involved.

An interview form has been designed to determine what children have learned from their experiences in the Center, but to the present time it has been used to a limited extent.

Reaction to the program on the part of children, teachers and administrators has been very positive. Presently a second Center is being planned for an elementary school now under construction. The second installation will provide a Center on the west end of the school district. The McDonald School is centrally located. A third facility may eventually be provided for the eastern section of the district. The school board and administration have made a commitment to elementary industrial arts and feel that it contributes significantly to the total education of the elementary school child.

In-service workshops scheduled during the summer have helped to introduce teachers to industrial arts. These programs have definitely contributed to the use of industrial arts activities by classroom teachers.

The 1968 workshop was held in two two-week sessions and involved a total of 80 teachers and administrators. Beyond activities involving the total workshop group, particular members of the Title III staff conducted sessions in Industrial Arts, Science and Media. Groups of 15 people each rotated between the different areas, so that each workshop participant spent at least 2-1/2 days in the IA Center. Teachers were introduced to and became involved in mass production, using tri-wall cardboard, pearlite and cement, and styrofoam.

The 1969 workshop involved 12 teachers for a period of one week. The objectives for the workshop were to: (1) have teachers examine their notions about IA within the context of elementary education based on their own experiences with IA as students and since becoming teachers; (2) describe how they would use an IA area if there were one available in their building or classroom, e.g., how IA experiences could be blended with their other teaching objectives. The participants were encouraged to explore and create what to them would be personally satisfying with the idea that they could then be able to teach or guide their pupils in a parallel activity at the students' own levels of interest and skill. During the workshop teachers focused their attention on any area in the IA Center that was of interest. Interaction was stimulated by teachers observing each other and trying new processes. The effect of their experiences was evident by the number of people who became involved with IA activities during this school year. Future workshops are being planned since this approach seems to be the most efficient way to implement a new program.

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Curriculum enrichment through an interdisciplinary approach

Lester J. Hamill, Jr.

Conquest of space. Each generation faces the challenge of new frontiers to explore. Space exploration is the most recent of these frontiers. The thrust of rockets has made it possible to explore the universe beyond the earth, thereby making it one of man's greatest adventures.

The conquest of space has moved ahead with breathtaking speed since the space age began on October 4, 1957. On that day, Russian scientists launched the first true space traveler, an artificial satellite called Sputnik I.

Less than four years later came the circling of the earth by man inside an artificial satellite. Less than a month later, on May 5, 1961, our own astronaut, Alan B. Shepard, Jr., broke the space barrier.

Scientists and engineers have utilized satellites to improve world communications and to check on the weather. Space satellites have given the military new weapons employment. To many, space accomplishments are very important because of the great national prestige involved.

No one can foresee what space travel may bring, for it is a new frontier that beckons to us as a new era in man's progress unfolds.

Statement of the problem. It was the purpose of the study to evaluate the merit of construction activity when related to other areas of the school curriculum through a unit study on space with the emphasis on colonizing the moon.

Evolution of the problem. The project developed from the fifth specific objective of the course, Industrial Arts in the Elementary School, taught at Millersville State College, Millersville, Pennsylvania, Graduate Division. The objective was stated to evaluate the merits of construction work when related to other areas of the curriculum.

The industrial, technological, sophisticated space age has materialized with a complexity of problems for the social and natural sciences. Fortunately, man has an unquenchable desire for knowledge to solve problems. The subject space has an elegance of enchantment about it that attracts man's inquisitive nature.

Man's curiosity is explained by the psychologists as the need to satisfy his curiosity through the need for knowledge. Considering man's curiosity to investigate and the enchantment of space seemed relevant in the selection of the problem in relation to the effectiveness of the problem.

Overview of the problem procedure. The hypothesis of the problem was discussed by the department chairmen and the teachers of the various subjects through an initial meeting scheduled by the administration of the school.

The group concluded that the problem showed many possibilities and work should begin at once with one eighth-grade experimental section. Each boy was requested to research, design, sketch, draw and build a scale model of a space object.

The library was selected as the site for resource material consolidation, with the placing of selected books on overnight reserve.

Simultaneously, the English department became the research division. The assignments of books, class reports and themes were given, followed by English class discussions.

The science department was the technical advisory area with the implementation of space age vocabulary and stimulating interest. An array of questions, concerning the Apollo flights, living in space, colonizing the moon, and the general conquest of space, contributed to stimulating discussions.

Inherently, the math department defined and discussed the multivariousness of mathematical knowledge necessary for a successful space program.

The art department then devised the scenery for the diorama depicting the colonizing of the moon.

Finally, the students proceeded to draw their orthographic drawings in the mechanical drawing room. The construction activity was then activated by the building of a scale model from their drawings. The value of model construction as a means to verify accuracy is cited by James S. Daugherty, "These models will at once show any error in the drawing which might otherwise be overlooked."

Let us now look at the study, department by department:

The Administration. The vice-principal's office arranged for the time of the planning meeting with the teachers cooperating in the project and provided the necessary coverage of classes.

By making several telephone calls, the vice-principal was able to locate and obtain the latest available from NASA. The individual contacted at NASA was Mr. George Gardner, Educational Program Director, NASA Information Center, Washington, DC (telephone 202-WO 2-2429). The Friendship Office of Martin-Marietta Company was also contacted.

The function of the school administration in the project has been one of encouragement, cooperation and assistance. Its interest is primarily one of search for improved cooperative methods of teaching boys and girls by capitalizing on their interest in contemporary meaningful events.

The Library. The library was responsible for obtaining, housing and circulating relevant materials.

These materials consisted of books, film strips, records, tapes, pamphlets and transparencies. They were placed on reserve for use in the library during the school day and for overnight circulation. One section of the main reading room was designated the "Middle River Space Program Research Center".

The English Department. The English Department was used as a research time. During their library period the students did research for their individual drafting projects. The theme was "Science: Fiction or Fact". Then they wrote science fiction themes based on travel or life on another planet. In the theme they had to describe what life would be like, what the planet would look like, the people and the type of spacecraft that was used. The last part of the project involved only the girls. This was done while the boys were doing research. They designed costumes for traveling as well as living on other planets. The fact part of this project was the research periods as well as a bulletin board on things that have happened in the space program.

The Science Department. The science part of the program concerned the teaching of the scientific aspects of space exploration. The students investigated the problems of space travel and living in the hostile environment of empty space. Many films, film-strips and models were observed and studied.

The Mathematics Department. The related studies in mathematics dealt with the physical structure and structuring of the facilities involved in building the space ship.

The points covered were: linear measurements, area, volume, tangents, cones, displacement, conic sections, frustrum of a cone, radius, diameter, scale drawing.

There was a surge of interest when the group saw that the principles of mathematics involved applied to the constructional activity.

The Art Department. The Art Department's part of the space program was to construct the space diorama with the moon surface as well as the earth. The students were involved to a great extent with the actual work of constructing a model of the earth and creating the moon surface of papier maché.

Basically, the main work of constructing the shell or framework was done in the Industrial Arts Dept. The framework of the diorama was of 12-in. shading with a back, rounded corner pieces and linoleum to give the appearance of a concave surface. Poultry netting was then attached to form the base for the papier maché moon surface. Craters, mountains and lunar ridges were also constructed of papier maché on the moon surface. The earth was made from a half plastic ball and papier maché. Upon completion of all parts, a coat of gesso was applied to the moon surface, earth surface and space background to present a semblance of different textural surfaces. Different colors of spray paint were used to contrast the three different parts of the diorama.

The Industrial Arts Drafting. The physical environment of the classroom was designed to keep the student in constant awareness of the model building activity in relation to the drawings. Consequently, the mechanical drawing classroom became the hub of the project, as advice or suggestions were given to the student in relation to his design.

Ideas. Each boy had to formulate his idea for the space project. Through research and class discussions it was learned that the design department is the nerve center of all manufactured products produced for consumption. Designers are constantly called upon for ideas that the engineers can analyze for feasibility of production.

Sketch. The student's sketch was required to show the shape, the dimensions and the necessary notes for construction. Only then was the sketch submitted to the instructor for approval.

Drawing. The orthographic scale drawing was constructed on buff drawing paper from the approved sketch. Unique problems created by design or difficulty in the students' ability to visualize arose as each student progressed with his drawings. The high interest problems adopted allowed many students to visualize a variety of problems on a first-hand experience under the direction and guidance of the instructor.

Model Construction. A separate area of the classroom was designated as the model-building area with the availability of hand tools, materials and a power jig-saw. Demonstrations were given by the instructor on the correct usage of model hand-tools and the safe operation of the power saw. Lessons were also given on the selection of model-building materials suitable for the individual models.

Then the construction of a scale model was completed from the orthographic drawing. Again the accuracy of the drawing was verified from the constructed model as cited by James S. Daugherty.

The speed of the students and the time schedule of the class dictated the completion of related assignments. Such assignments as the tracings and reproduction prints of their design were completed by some of the students. Also several students constructed a pictorial drawing of their design in either oblique or isometric.

Drafting Summary. The merits of the construction activity were evaluated by the author's observation, student drawing grades and a unit test. All criteria indicated that the program was successful.

Summary. Dr. Mary-Margaret Scobey stated that "industrial arts should be an integrated part of the total curriculum, supplementing and supporting, with knowledge unique to the field of industrial arts, the social sciences, mathematics, science and the arts."

Dr. Scobey's philosophy was directed toward the elementary school where industrial arts is not a separate subject. However, the same philosophy can be applied in the junior high school to create a learning environment. This was evident as one successful project was correlated with various school subjects and the industrial arts drafting department.

The consolidation of educational materials placed in the school library was conducive for research conducted by the English department. Their theme, "Science: Fiction or Fact - Destination Moon", correlated well with the science classroom discussion and films that illustrated the problems of space travel and living in the hostile environment of empty space. A large diorama constructed in the art department enhanced the display of models and gave meaning to all departmental learning experiences.

The experience produced an abundance of information that not only broadened the student's storehouse of knowledge, but also reinforced his understanding and appreciation of the regular subject matter, as stated by Marshall L. Schmitt, specialist for industrial arts, US Office of Education:

> Experiences gained in industrial arts courses can be an adjunct to many other school courses. The work of designing and making an object (or a working model of it) described in one of the regular-course textbooks or discussions brings the student a double reward: (1) It reinforces his understanding and appreciation of the regular subject matter. (2) It gives him valuable information about the basic tools, materials and processes of industry and a new conception of the technology which undergirds our society.

We may conclude that the constructional activity (model building), when related to other areas of the curriculum, was extremely successful as viewed through: (1) Enthusiastic teaching as demonstrated by the congenial teachers involved, along with the support of the administration; and, (2) the high student interest as displayed by their attitudes as they gained considerable knowledge about space.

Participants' comments. Mr. J. Heuisler Streett (Principal): An excellent project, Question: How could this type of project be expanded to include more pupils?

Mr. J. Andrew Baummer (Vice-principal): This illustrates a method of teaching boys and girls, by capitalizing on their interest in contemporary meaningful events.

Mr. Donald Maxwell (English Dept. Chairman): When our new literature curriculum was being developed, a definite effort was made to design the curriculum along lines of student interest. The theory is that students will work better and learn more if the courses deal with facets of modern teenage life and interests. This project fits the bill neatly; its success here at Middle River is proof of this.

Mr. Thomas Reed (Science Dept. Chairman): I was impressed with the interest and the cooperation shown by the teachers from the various subject areas who participated in the project.

Mrs. Dorothy Harris (Head Librarian): A steady flow of visitors, day after day, visits the display placed in the library. Groups of children from the elementary school gaze in amazement. Elementary teachers will comment to the children that they too may participate in studies of this nature with hard work and effort.

Mr. Kermit Stong (Science Teacher): In nine years of teaching, I found this to be one of the best units that I have ever taught. I found this unit uplifting and invigorating due to the necessary forethought and research required in this type of creative teaching.

Mrs. Barbara Mahon (Mathematics Teacher): There was a surge of interest when the group saw that the principles of mathematics involved applied to the constructive activity.

Miss Cheryl Starn (English Teacher): I thought the moon project was excellent. The kids who participated were quite motivated and proud. They have a real feeling of satisfaction. I think it's good to give kids a project as this to display; it seems to instill motivation and ambition. I only wish I could have been able to plan a more extensive unit in English to go along with it.

Mr. Elmer McDorman (Art Teacher): I was pleased as my homeroom happened to be the group selected to work on this project. Very well received by the students.

Mr. Lester J. Hamill, Jr. (Drafting Instructor): This successful project could only have been accomplished through the cooperative effort of enthusiastic teachers with the support of the administration and students with an interest.

Comments by students. (1) Learning about space was fun! (2) I didn't know there were so many books about space. (3) The films on space were sure neat! (4) Did you see the Saturn rocket in the science room? Wow! (5) I didn't mind writing themes about space. (6) How about our bulletin board in English class? (7) Frustrum of a cone, what? (8) We did the diorama! (9) A model of what? on the moon? You're kidding! (10) I was only one-sixteenth of an inch off with my model! (11) I know more about space than my father, how about that? (12) Can we do something like this again? When?

Devices or Aids Necessary for the Project

Miter box. The problem of obtaining square cuts on small pieces of balsa wood arose that necessitated the construction of baby miter boxes.

Special tool panel and work table. The area set aside for model building contained an existing tool panel with basic hand tools; however, unique problems required added tools. Also styrofoam was added to the material supply, which created extra tools in the form of battery-operated cutters.

Diorama. The frame for the five-foot diorama was constructed in the industrial arts woodshop by Mr. Clayton Hurst. The inside of the frame contained several ten-inch regular ribbings, placed eight inches apart. Linoleum was adhered to the irregular contour ribbing to create the backing for a three-dimensional, perspective appearance. The diorama was sent to the art department for completion.

Camera Stand. The entire problem was documented with 35mm slides and tape recordings. The close-up photography made the construction of a copy stand necessary. Plans were obtained from Kodak.

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Mr. Hamill is a drafting instructor in the Baltimore County (Maryland) School System.

Industrial arts for elementary grades—program and procedures in New York State

Jarvis Baillargeon

New York State's involvement with industrial arts for the elementary grades extends back over a period of over 30 years. We have in our files locally-prepared curriculum materials from the Great Neck and Roslyn school systems dating to 1950. Substantial programs were developed in the New York City Schools, Rochester City Schools and at other locations around the State. During this time, however, there was little definitive direction, and major reliance was placed upon the personality of the program director. And this would appear true today. Major research studies and Federal proposals hinge upon the interested and able personality who can organize, first, a proposal, and, secondly, an implementation.

Upon assuming a responsibility for elementary-level industrial arts for New York State, I endeavored to research current materials for elementary level industrial arts. After reviewing the literature, I visited locations where elementary industrial arts was operational, including the Long Island Schools, State University Campus Schools, private schools and one out-of-state project in the field. On the basis of this study I prepared a memo to my Bureau Chief, Arthur Dudley, outlining what I had seen and making recommendations for proceeding with contacts with school administrators in the field. This memo has been used as the basis for a brochure.

Approaches, outcomes and types of service. Elementary-level industrial arts appears to have several diverse facets. There are distinct approaches, services and outcomes. The problem is to identify a package providing for three separate outcomes: one, instruction in technology; two, pupil activity for physical, emotional and social growth; three, a close relationship with ongoing instruction in the grade level classrooms.

There appear to be three distinct approaches in EEIA classrooms that I observed: first, the arts and crafts approach; second, the materials and project approach; third, the classroom correlation approach.

Implementation of the arts and crafts approach takes the form of leather kits, Indian hammers, birch canoes, etc. The materials and project approach seems to stress wood projects, with the students building a gift for mother for Christmas, a dish for Easter or a window stop for Memorial Day. The classroom correlation approach is best described as a continuous support facility without self-identity of discipline content.

Matching the three approaches with the three outcomes gives insight into program organization. Arts and crafts provide activity but little technology or correlation; materials-oriented instruction provides activity and some technology; classroom teacher-selected group projects provide correlation and activity. None provides all three.

There are also three basic types of service provided for elementary students. One places a workbench and hand tools in the individual classrooms, by the consultant; a second is based on movable 'carts' which are wheeled into individual classrooms; and the third provides a work center into which groups of children are scheduled. Experience by practicing teachers suggests that the 'cart' system is least effective, and that a combination of an established work center with supplementary workbenches in the classrooms (on teacher request) provides the opportunity for effective and meaningful experiences.

Essential elements. My research leads to the conclusion that program organization to provide for the desired outcomes involves a distinctly new factor. This is the selection of an area of content for each grade level, such as is done by other subject matter fields, as a base for classroom correlation. This provides for the outcomes: technology, activity and correlation plus giving integrity and identity for the subject and the teacher.

Here we have then the first of three elements that I consider necessary to present an industrial arts program at the elementary level on a continuing basis.

--Systematic instruction should focus upon a single theme for each grade while permitting latitude in supporting ongoing classroom studies.

On the basis of observation of teachers, at work, and an examination of elementary teacher education curricula, it seems clear that in order to provide for success in the manipulation of tools, materials and processes, quality instruction needs a pair of 'trained hands'. This points up the second element:

--Purposeful use of tools and materials requires a specially-trained teacher.

While it is possible for the elementary teacher education graduate to be very capable, it would be uncommon to find many teachers with this level of ability. It is possible that elementary teachers could achieve a measure of skill in summer institutes. However, I personally feel that it would take more than a course or two to qualify a person as a 'specially-trained teacher'.

The third element necessary to present a program on a continuing basis relates to the facility in which the teacher will live and the students will work. After visiting classrooms, closets and shops, I came to the conclusion that:

--Effective use of tools and materials requires a specially-equipped workroom.

While not ideal, a classroom may be used as a teaching station, provided group size is held to about fifteen at any one time. A quantity of simple hand tools, holding devices and workbenches are necessary for instruction. The consultant will need power tools to prepare materials. Supplies range from softwoods, plywood, wood shapes and fiberboards to light metal, wire, plastics and fabrics. Provision for storage of materials and projects is essential.

Implementation. On the basis of these three elements I can now discuss with a school administrator what is required of the district to implement industrial arts at the elementary level. He knows that when I recommend a specially-trained teacher that his first endeavor is to seek out an industrial arts teacher with some background in elementary education either at the experience level or at the education level. He knows that it will be necessary to provide a room with equipment, storage and all the rest as a home base for this teacher. This in effect establishes a dollar value for the program. Starting from scratch it may cost up to $5,000 to provide an elementary teaching station. One station could be expected to provide service for about five hundred students or approximately 15 to 18 teachers.

Implementing the three elements places a teacher in contact with groups of children in an equipped workroom with a focus for group and individual project activity. The scheduling procedure should begin with conferences with the classroom teachers to select activities which relate the grade level theme with planned classroom instruction.

K-12 program. It should be noted that elementary-level industrial arts is a part of a kindergarten-grade 12 program. This means that the elementary package must relate to the same purpose and goal as do the junior and senior high portions of the program. Additionally K-6 content should provide background and support, but not repetition, for those parts of the program which follow. Additionally in New York State we now find that many junior high schools are being phased out in favor of what is called a middle school. These may begin at grade 5 and continue through grade 8, followed by a secondary school for grades 9-12. Content then must be divisible into primary level instruction, K-4; intermediate level instruction, grades 5 and 6; early secondary instruction, grades 7 and 8; and secondary level instruction, grades 9-12. To provide a continuum, a series of aims for the different levels have been identified. The aim for primary instruction is an Orientation to the Nature of Work, at the intermediate level the aim is Exploration with Tools, at the early secondary level the aim is Utilization of Materials and Forces and at the secondary level the aim is Experiences with Industrial Technology.

Each level of the program is designed to support the following:

Educational Purpose: Productive Citizenship
Mission: Interpret Industrial Technology
Goal: Technological Adaptability for the Individual

In 1958 the New York State Education Department's Bureau of Elementary Curriculum Development produced a publication entitled Let's Make It. This publication is now out of print, but it established a rationale for tool and material activity in the elementary grades.

Other publications by the State Education Department in the various subject matter fields provided an insight into the areas of content which were offered in English, social studies, science, math, music, art and others. While my research was not nearly as definitive as Dr. Hoots', nor as expansive as Dr. Scobey's, it provided an opportunity to subdivide technology into seven groups, one for each grade K-6.

An assessment of the capability and interests of students coupled with a survey of subject matter content from other fields suggests the following as grade level technological themes:

N-K Work Environment-Activities focus upon the concept of 'work' as a fundamental 'good' for the individual and society.
1 Service-Activities support the concept that employment in-service functions make a contribution to society.
2 Manufacturing-Activities center on the division of labor into specialties which permit the efficient mass production of products.
3 Communications-Activities focus on the media used to control, extend and give permanence to mass communications.
4 Power-Activities are based upon the application of machines to convert energy into useful work.
5 Construction-Activities relate to the structures in which people live and work.
6 Transportation-Activities center on the vehicles and facilities used to transport people and goods.

These areas when followed by functional instruction with materials, graphics and forces at the 7-8 grade level, provide children with the basics of technology relating to the industrial arts goal of 'technological adaptability' for productive citizenship. These then are the recommendations which are offered to elementary administrators as a part of our regular supervisory work.

Content can be provided by researching printed materials, assigning activity suggestions into one or the other of the grade level themes. A tool-equipment list has been derived so that an administrator contemplating introduction of the program may have some specifics with which to work. The Bureau of Industrial Arts is prepared to assist districts in implementing instruction in technology at every level, K-12. We hope that in the years to come an interest in activity programs for young students will be translated into programs of industrial arts education at the elementary level.

Mr. Baillargeon is associate supervisor in the Bureau of Industrial Arts, New York State Education Department, Albany.

National Conference on Elementary School Industrial Arts: a report

William R. Hoots, Jr.

Twenty-one people concerned with elementary school industrial arts were brought together during the 1969-70 school year to consider the subject of elementary school industrial arts. This was made possible by a grant from the US Department of Health, Education and Welfare, Office of Education.

Participants were selected who were representative of a wide range of approaches to elementary school industrial arts, and they came from many areas of the United States. There were representatives from industrial arts and elementary school teacher education, supervisors of both industrial arts and elementary education, and persons involved in directing and teaching industrial arts in the elementary classroom. The intent in selecting participants was to bring together a representative sample of all philosophical points of view from all levels of education.

The major goal of the National Conference on Elementary School Industrial Arts was to provide national leadership and unity to elementary school industrial arts. The specific objectives of the conference were as follows:

(1) To identify the various approaches to elementary school industrial arts and to reach a common understanding of the nature of industrial arts for the elementary school.

(2) To identify methods of implementing industrial arts in the elementary school.

(3) To identify the various types of staff preparation necessary for conducting programs of industrial arts in the elementary school and to identify the educational programs appropriate for teacher education.

(4) To determine methods appropriate for disseminating information about elementary school industrial arts.

(5) To provide recommendations to the US Office of Education and other concerned agencies on the types of programs that should be encouraged in promoting better education for children through elementary school industrial arts.

While the objectives of the conference were not fully achieved, a solid philosophical foundation was developed and an agreement as to the nature of elementary school industrial arts was reached. The reports by committee representatives that follow indicate the solid foundation that was reached. This was a start, a beginning, which must continue if national direction and a degree of unity are to become realities.

Dr. Hoots is on the faculty at East Carolina University, Greenville, North Carolina.

A basis for elementary school industrial arts (committee report)

Thomas J. Jeffrey, et al.

The development of a basis for elementary school industrial arts requires the formulation of a definition and a statement of philosophy. These serve as a foundation upon which communication components can be developed and which should form the basis for selecting instructional activities.

Definition of elementary school industrial arts. Industrial arts at the elementary school level is an essential part of the education of every child. It deals with ways in which man thinks about and applies scientific theory and principles to change his physical environment to meet his esthetic and utilitarian needs. It provides opportunities for developing concepts as a result of concrete experiences which include manipulation of materials, tools and processes, and other methods of discovery. It includes knowledge about technology and its processes, personal development of psycho-motor skills, and attitudes and understandings of how technology influences society.

Philosophical bases. Public schools in the United States are committed to a general education developing the full potential of all children. School systems differ widely in their approach to the child, the environment and learning experiences. There is a divergence from highly-structured to non-structured programs. For the most part, learning has been oriented to the verbal and symbolic; provisions for developing the non-verbal abilities of each child have not been emphasized.

Each child brings to the learning situation a unique profile of development resulting from the sum total of his past experiences. Therefore educators must recognize and deal with individual levels of development in such personal characteristics as attitudes, values, self-concept, knowledge and psycho-motor skills.

Recognizing these individual differences, there are two fundamental dimensions in which the educational process operates and for which the educator must assume responsibility. The first is the physical setting, which includes materials, facilities and media stimulating both verbal and non-verbal responses in the learner. The second is the mode of the organization, governing the ways in which the children operate in the physical setting. A flexible learning situation sets the stage for interaction, exploration, experimentation, problem solving and concrete experiences that satisfy aesthetic and utilitarian needs. Learners are provided opportunities to assume responsibility, make decisions, think, receive immediate feedback and express themselves freely.

Industrial arts for the elementary school can satisfy these conditions. The uniqueness of industrial arts lies in the fact that its activities can provide a greater variety of elements that enhance the learning process than any other single discipline.

Concrete experiences. The major emphasis is upon concrete experiences which deal with manipulation of and exploration with materials, tools and processes. While processing the change of materials (from raw to contrived) and fabrication objects, the child is involved in the physical and sensory interaction with things. Through first-hand experience, he learns the characteristics, potential and limitations of materials, and their cultural functions.

Thought processes. The thinking process, unique to technology, involves problem-solving based upon the manipulation of materials. The more frequently children experience problem-solving situations, the more fluent become their thought processes and the more easily they can make new associations. They are increasing their abilities to interact through the language of forms. They are building ideas about technological production and the social influences of technology. They are learning to live effectively in a technological culture.

Learning processes. Through industrial arts experiences, learning may become relevant, lasting and both individually- and socially-oriented. The optimum learning situation provides: sensory data input through all sensory channels, immediate feedback, opportunity to think in a problem-solving way, opportunity to try out ideas and test them against reality through other than verbal tests, and opportunity to nurture creativity.

Personal abilities. The dynamic industrial arts program will foster the development of the following personal abilities: to think concretely or to lessen degrees of abstraction; to act with autonomy and self-direction; to solve each problem as it occurs; to make judgments; to increase control of the total body to perform tasks; to be increasingly creative and to perform creative operations at higher levels or degrees; and to develop organizational ability through more sophisticated levels.

When one makes decisions to change materials, one must make organizational commitments. One must pre-organize actions which are different when dealing with concrete objects rather than with verbal symbols.

Self-concept. An increasingly positive self-concept can be developed when children find success in the manipulation of materials. The planning, production and completion which translate a visual image into a concrete form provide multiple satisfactions. The drive to mastery of something outside of the self is satisfied; desire for competency is innate within us all. One may take pride in individual accomplishment, in recognition from others and the resulting extension of self.

World of work. Understanding of industrial processes and insights into manufacture and production, as well as exposure to and contact with the physical and material world, facilitate orientation to the world of work. Students attain respect for craftsmanship. They learn to appreciate ability in others, both in technical skills and talents other than manipulation. These appreciations enhance human relationships. They help individuals recognize their own place as contributors to the social system, and the accompanying sense of accomplishment and involvement.

Mr. Jeffrey's committee included Dr. Mary-Margaret Scobey, Chairman; Miss Elizabeth Hunt, Donald Hoffmann and Vito Pace, representing California, North Carolina, Pennsylvania and New York, respectively.

Teacher education for elementary school industrial arts (committee report)

Robert G. Thrower

The Teacher Education Committee of the National Conference on Elementary School Industrial Arts, believing that a study of technology is essential in the total development of children, strongly advocates that industrial arts be an integral part of the elementary school curriculum. The committee recognizes that special preparation is needed by the teachers who will be conducting these elementary school industrial arts activities. This being the case, pre-service and in-service courses must be offered by teacher education institutions both for elementary school industrial arts specialists and for elementary classroom teachers.

After many hours of attention to this subject of pre-service and in-service education for those individuals who will be working in the field of elementary school industrial arts, the committee has identified nine essential components of any teacher education program. The nine essential components are as follows:

Philosophical base. The success of any educational program is dependent upon the philosophy of the personnel who are charged with the responsibility for organizing and conducting the program. Teacher education programs must help teachers to develop an understanding of the philosophical base previously discussed in the report of the Philosophy Committee.

Tool and material exposure. An essential element in the preparation of teachers who will incorporate industrial arts is a thorough exposure to the tools and materials of technology. This exposure must include manipulative experiences to develop a level of confidence that will make the teacher feel comfortable in the use of tools and materials. There also needs to be an understanding of what tools children at various stages of development are capable of using safely and successfully. This necessitates an understanding of the physical development of children.

Technological content. Another essential component in the preparation of teachers is a fundamental understanding of the technology from which the content of industrial arts is derived. This content needs to be thoroughly investigated in terms of what is appropriate for each grade level, how it can best be integrated into the curriculum of that particular grade, and what manipulative activities will best promote the study of the technology.

Environment for learning. An environment for learning must be one in which children may become totally involved in the learning process. This process involves many forms of learning, including abstract concept development and manipulative exploratory experiences. Each classroom must provide ample opportunity for children to participate in formal and informal learning arrangements, including print and non-print media, utilizing a variety of tools and materials. The facility must provide for the multitude of ways in which children learn and for varying rates of maturation.

Teacher education programs must emphasize the need for modifying existing classrooms to more broadly-conceived educational arrangements. The environment must be flexible enough to allow constant change to take place. Tools and materials must be part of the total educational setting. Each item injected into the classroom affects the learner by directly influencing what he learns, how he learns, and the attitudes he develops toward other students and the school.

Opportunity to apply learnings with children. Children are the focal point of all elementary school industrial arts teacher education programs. Throughout their professional preparation all prospective teachers must come into contact with children. Micro-teaching in an observation of on-going programs should be a part of all teacher education programs. This systematic inclusion of teacher-pupil contact is essential to the success of the teacher.

Involvement of resource persons. Elementary school industrial arts is concerned with children developing an understanding of technology and its effects upon man and society. The fact that technology touches every aspect of man's being necessitates the services of other resource persons in addition to industrial arts teacher educators. Ecologists, anthropologists, sociologists, industrialists and psychologists are but a few of the resource persons who should be used to supplement the instruction in an industrial arts teacher education program.

Involvement of community resources, physical and human. Community resources are a vital part of the elementary school industrial arts program. The education of the elementary child should extend beyond the confines of the classroom. Teachers must develop an attitude conducive to the involvement of community resources and their effective utilization in the program. The utilization of these resources strengthens the relationship between the school and the community.

Techniques for gaining administrative involvement. School board members, administrators and supervisors must be well informed if they are to be effective leaders of education in the elementary school. They must understand the purpose, functions, content, contributions, potential, problems and costs of elementary industrial arts programs in order to support them. Specific techniques can be utilized by elementary industrial arts personnel to elicit the support of administrators and board members. Since it is in the interest of the teachers to know these techniques, they should be included as topics of instruction by the institutions conducting pre-service and in-service courses.

Program evaluation. Evaluation is a necessary part of any educational process, and effective evaluation can be accomplished only after objective evaluative criteria have been established. Institutions preparing elementary school industrial arts personnel must include specific techniques for developing the criteria and means of using them in the classroom.

Dr. Thrower, of Trenton (NJ) State College, chaired this committee, which included William A. Downs, John J. Geil, Dwayne Gilbert, Joseph Haslett and F. Arthur Stunard, representing Missouri, Florida, Louisiana, Virginia and Illinois, respectively.

Implementation Committee report

Larry T. Ivey

The report presented herein represents many hours of deliberation by the committee on implementation of elementary school industrial arts. This committee was composed of the following persons: Dr. Fred Dreves, chairman of the committee, Mrs. Norma Heasley, Richard Wood, Wayne Wonacott and myself.

We realized the difficulty in developing a course of action to facilitate implementation on a national scale. Our main objective has been to develop a guide which will assist educators throughout America in designing and implementing programs of elementary school industrial arts.

Our first task was to recognize current problems in implementation and to come up with possible solutions to those problems. We recognized three basic problems and developed a guide to help solve those problems. Our first area of consideration was leadership. We recognize that if elementary school industrial arts is to take its logical position within our schools, it must have effective leadership. To be effective, this leadership must play a key role and must have responsible persons characterized by having understanding of child behavior, familiarity with elementary curriculum, knowledge about trends and issues in elementary school industrial arts, and experience in industrial arts education for children.

This committee has indicated three levels where strong leadership is needed. These are the national, state and local levels of education. Along with these levels of leadership there is also needed an effective and continuous system of communications among the various leaders.

At the national level, this committee recommends the establishment of a national commission responsible for:

(1) Researching available means for funding elementary school industrial arts programs.
(2) Developing broad goals at a national level.
(3) Establishing guidelines for curriculum development, equipment and materials selection, teacher education and program evaluation.
(4) Assisting in planning and developing pilot programs throughout the United States.
(5) Researching and disseminating available information about existing programs of elementary school industrial arts through cooperation with professional and industrial organizations.

Our second level of concern for leadership is at the state level. There should be a director of elementary school industrial arts in each state supported by state and/or Federal funds. The state director should be responsible for:

(1) Coordinating efforts with local and national leadership.
(2) Implementing programs in his state by assisting local agencies in planning and developing programs of elementary school industrial arts.
(3) Compiling resource materials and making them available to local programs.
(4) Serving as liaïson and coordinator of the efforts of various sections of his state department and industrial arts educators in the development of curriculum and instructional materials.

The third level of leadership is one which is indispensable if we are to have good programs of elementary school industrial arts. This third leadership is at the local level where each educational district should have an industrial arts consultant as a member of its professional staff. The industrial arts consultant would promote a good program of elementary school industrial arts through his leadership role by:

(1) Working with members of the curriculum and supportive staffs to establish industrial arts as an integral part of the curriculum.

(2) Coordinating the efforts of teachers and administrators to improve instruction and enrich the curriculum with industrial arts experiences.

(3) Making available to teachers and students materials, media and other instructional aids.

(4) Working to improve the image of industrial arts within local communities.

(5) Supporting and assisting an on-going program of objective and subjective evaluation.

The concensus of the committee on implementation is that leadership, as described above, is an essential element which must be present at all levels of education if industrial arts for elementary schools is to prosper and grow with elementary education in the United States. The committee was unanimous in stating that without effective leadership, elementary school industrial arts could not be implemented on a national scale in a uniform manner. Good leadership is required to implement elementary school industrial arts effectively into the schools of this nation.

The second area for comprehensive consideration deals with identifying and explaining the various approaches currently in existence for implementing industrial arts into elementary education.

The organization and administration of industrial arts programs in the elementary school fall into several general categories. There is a vast difference between minimum programs, both in content and facilities. Most elementary school programs are directed by the regular teacher in the classroom, utilizing portable tools and equipment. A few programs involved a specially-trained teacher who, in cooperation with other teachers of the school, directs the work in a laboratory or permanent facility. Between these two extremes is a variety of programs which are successful and need some explanation.

Elementary school industrial arts programs fall into the following general categories:

I. Limited Classroom Program
II. Comprehensive Classroom Program
III. Laboratory Program
IV. Traveling Teacher Program
V. Mobile Laboratory Program
VI. Central Laboratory Program
VII. Summer School Enrichment Program
VIII. Any combination of two or more of the above.

The philosophy of the local school district, budget, time, classroom or laboratory space and personnel determine the approach to industrial arts which a school district might select.

Limited Classroom Program. The majority of elementary school industrial arts programs falls into this category. The term 'limited' refers to the classroom time allowed for the subject, to the tools and materials available and to the direct assistance available from an industrial arts consultant. The activity is usually integrated with other subjects of the elementary curriculum through tools skills, experimentation, problem solving and the appreciations of various industrial processes.

This category can be characterized as follows:

(a) The program is directed by the classroom teacher.
(b) The work is correlated with other subjects.
(c) The activities are usually limited to blocks of time, units or episodes.
(d) A minimum number of hand tools is available.
(e) Tools and equipment are portable.
(f) The services of an industrial arts specialist are minimal.

Comprehensive Classroom Program. In this type of program the classroom teacher has the advantage of regular assistance from an industrial arts consultant. School visits by the consultant are frequent, and usually many teachers of several grades are involved in the industrial arts program. A course of study is set up for all grades, and there is planned articulation from grade to grade. This program is characterized as follows:

(a) The classroom teacher directs the work in close cooperation with a specialist.
(b) The industrial arts activities relate to other subjects, to the study of technology, and to the discovery of personal abilities.
(c) The industrial arts specialist does not "take over" the program but does

provide active assistance to classroom teachers and students.

(d) The activities and content dictate the numbers and kinds of tools that are needed.
(e) Tools and equipment are portable.
(f) The work is scheduled on the basis of a semester or a school year.
(g) Regular courses of in-service training are offered to teachers.

Laboratory Program. The trained industrial arts teacher who leads a laboratory program has a dual role to play in the elementary school. He directs a balanced industrial arts program for the children of the school in cooperation with the classroom teachers, and he gives these teachers sufficient in-service training to meet more nearly the total needs of the children.

The industrial arts teacher has an excellent opportunity to give children a variety of experiences which reflect modern technology and still maintain a balanced relationship with the elementary school curriculum.

The ideal laboratory teacher is one who has an industrial arts background and has had some training or experience in elementary education.

Laboratory programs are characterized as follows:

(a) The industrial arts teacher directs the activities.
(b) The classroom teacher cooperates in planning the work, and he assists in carrying out the objectives of the work.
(c) The industrial arts work is subject-oriented, yet it will complement the general elementary course of study.
(d) A regular schedule of classes is set up for each semester or for the school year.
(e) The course of study would be articulated by the cooperative efforts of the industrial arts teacher and the classroom teachers.
(f) Tools and equipment are appropriate to the content.

Traveling Teacher Program. The traveling industrial arts teacher functions in about the same way as the laboratory teacher in category III: He works in the classroom, laboratory or multi-purpose room.

The traveling industrial arts teacher:

(a) visits two or more schools on a regular schedule and teaches children;
(b) plans the program with the classroom teachers and the local administrator. (The work centers around local student needs.); and
(c) uses tools and equipment permanently assigned to each school.

Mobile Laboratory Program. The mobile laboratory has been used mostly in rural areas where schools are far apart and each school is unable to afford tools and equipment of its own. This mobile unit may serve as a laboratory, or tools and equipment may be moved to other work areas. The equipped van or trailer can serve as an in-service training facility for teachers at the end of the school day.

The mobile laboratory teacher:

(a) moves from school to school in a self-contained unit;
(b) works with children in the unit in a classroom or other convenient work areas;
(c) plans and works cooperatively with the faculty to serve local needs;
(d) conducts in-service education for teachers; and
(e) provides workshop facilities for the construction of teaching aids and accessories.

Central Laboratory Program. Certain circumstances may require the establishment of a centralized industrial arts teacher in a facility designed for comprehensive industrial arts activities. A special effort must be made to coordinate industrial arts with classroom instruction.

Summer School Enrichment Program. Many school districts offer enrichment studies as well as remedial work in summer programs. Art, music, drama, science and industrial arts activities have been highly successful in various summer school organizations. Rather than spend a full summer school day on one subject, there have been some rather innovative combinations, such as theater arts, math, science and others, all combined with industrial arts.

The summer period provides many opportunities for experimentation in various programs, and for the in-service training of teachers.

Combination of two or more approaches as outlined above.

The third and final area of implementation for this report concerns the actual planning and conducting of activities and experiences for elementary school industrial arts.

The committee recognized a need for the formulation of a vehicle of instruction to guide teachers in planning learning experiences for students.

When the scope and sequence of an industrial arts program have been determined, suitable plans for maximum learning in an orderly environment need to be developed. The following outline may assist the industrial arts specialist and/or the classroom teacher in organizing instruction.

Children's Learning Activity Procedure

I. Title: The title should give a clear picture of what is to follow in the content.

II. Rationale: The rationale includes the basic reasons for the activities and the justification for the children's experiences. The statement may introduce a problem-solving situation, it may prepare content for orderly confrontation, or it may present an activity to satisfy a need arising from other areas of the curriculum.

III. Concepts: The basic concepts of an instructional unit should be stated so that the objectives and activities selected are directed toward understanding these concepts.

IV. Behavioral Objectives: Behavioral objectives should clearly state what is to be accomplished by the students, so they will know what they will be provided to work with, what performance is expected of them and what criteria will be used in their evaluation. The objectives provide the basis for selection of learning activities and experiences.

V. Learning Activities: Once the objectives have been stated, activities and experiences should be selected to help students obtain them. The child should have a major role in the selection, planning and execution of these activities.

VI. Evaluation: Evaluation techniques must be utilized to determine if and when the objectives have been achieved. Evaluation should comprise both subjective and objective means for determining outcomes.

In concluding this report, the committee on implementation realized that much additional time and energy are needed to develop a total system for implementing industrial arts into the elementary schools of our great nation. We are hopeful and optimistic that this task will be accomplished in the near future. You can be a great help by telling other educators about elementary school industrial arts and by providing them with assistance in implementing their programs.

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acias general session addresses

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The relevance of the new industrial arts in Prince William County, Virginia

John Edward Bonfadini

Is what we are teaching in today's industrial arts relevant to today's society? Prince William County, Virginia, is attempting to resolve this question by implementing the "New Industrial Arts". The curriculum presently employed is a combination of many ideas and does not reflect any one thought. Olson, Maley, Lux and others have contributed to our present program development. It is our opinion that many relevant programs already exist and that implementation is the major problem.

Industrial arts in Prince William County begins in the middle school, grades six through eight. Sixth grade students and teachers are given an opportunity to utilize the industrial arts facilities as a resource area. Work activities are related to the sixth grade curriculum, and a team teaching approach utilizing sixth grade and industrial arts teachers is encouraged. An example of this concept is the industrial arts teacher acting as a resource person in helping students build maps of various countries discussed in social studies.

Seventh and eighth grade students are required to enroll in a half-semester of industrial arts. Since the majority of Prince William County middle schools are designed to house 1000 students, three industrial arts laboratories are required to meet program demands. Each lab is equipped to relate to two specific materials, such as, Lab I, wood and plastics; Lab 2, metals and power mechanics; and Lab 3, graphics and electricity. Although the three labs are employed, the curriculum dictates using the facilities as though it were one large general laboratory.

Students in the seventh grade rotate through the areas of wood, metal and graphics. Although students rotate every six weeks on an area concept, emphasis is placed on the teaching method and not the area. In relating to the area of wood, the unit approach is used. Units studied are usually anthropologically based and cover the topics of transportation, shelter and weapons. These units closely relate to course content studied in other classes, thus increasing the relevance of this program. The class selects the unit for study, and each student selects his own sub-topic. Student activities center around researching, reporting and model building.

After participating in wood for six weeks, the students rotate to a different lab and program. In the graphics area, photography, silk screen and basic mechanical drawing are taught. The unit approach, group approach or individual approach may be used. Small- and large-group activities are encouraged.

Completing the semester, the students move to metals, where emphasis is on the individual project approach to teaching. Design and creativity are prime considerations in the selection of the individual project.

Eighth grade students obtain exploratory experiences in power mechanics, plastics and electricity. Power mechanics activities center around the internal combustion engine, basic power measurements and applications of power. The experimentation and maintenance-repair approach works effectively in teaching power mechanics. A keen interest in power usually exists with most students and repairing a malfunctioning engine to operate efficiently has delighted the hearts of many students.

The experimentation and research method can be used successfully in electricity. Students work from kits, designed and built by instructors. Using hardware developed by the immediate personnel increases the relevance and effectiveness of its usage.

The area of plastics readily adapts to the line-production teaching technique. The fluid and pliable nature of plastics permits students easily to develop molds, jigs and fixtures necessary for line production. Incorporating plastic equipment, such as injection molders, laminating presses and vacuum formers, can exemplify the production concept of producing a multiple product. Due to the limitation of time, most line-production products are teacher-student-designed.

To successfully operate this type of program, the instructors must function as one team. Each junior high team decides on the approach to be used in each instructional area. Precautions are taken to give the student a variety of teaching approaches, and the elimination of duplication in teaching methods is encouraged.

Although many industrial arts programs have been developed for the junior high school, relatively few exist at the senior high level. The Maryland plan has basically functioned at the junior high level, with some efforts being made to initiate this concept in a senior high program. The Industrial Arts Curriculum Project emphasizes the junior high level, and other programs tend to favor experimenting with this age group. Efforts to explain the lack of senior high programs seem to hinge on defining the role of industrial arts and its relationship to vocational education. In many areas it is extremely difficult to differentiate between an industrial arts unit lab and a vocational lab teaching the same subject. Time is the only factor in many cases.

In establishing a sound industrial arts program, Prince William County felt it should first define the objectives of industrial arts. Once these objectives were defined, a program to implement them was developed. Each course was written to accomplish specific goals of industrial arts for a particular concept. Each concept attempts to be unique and separate from previous or subsequent programs. Each course contributes to the student's understanding of certain major facets of industrial technology. The completion of all levels provides the student with a continuum of experiences designed to educate him to live in a technological culture. Having established these objectives, the following courses were initiated: manufacturing, construction, materials and research, and communication.

Prince William County senior high schools consist of grades nine through twelve, with industrial arts electives available at all grade levels. Approximately 1500 to 2000 students are enrolled in each of the county's four senior high schools. Recent statistics indicated that industrial arts enrollments ranged from 18% to 28% of the total school population. Since the majority of industrial arts students are male, this means that each year about 50% of the boys are enrolled in industrial arts.

Manufacturing is the initial course available to all students. The primary objectives of manufacturing are to acquaint the students with: Industrial organizations and processes, technology of manufacturing industry, the types of tools and machines used in industry, and historical and social significance of industry.

Student activities center around the unit approach, the group industry approach, the mass production approach, and the individual project approach. The unit approach emphasizes industry and its historical significance. Manufacturing units comprise areas having direct industrial bearing, such as, power and energy, inventions, and tools and machines. Since most students are exposed to the unit method in the junior high by studying the technological areas of transportation, weapons and shelter, the basic objective of the unit is to increase the students' depth and understanding of industry.

The group approach is adapted to the study of a manufacturing industry. The student activity involves the making of a large scale model illustrating the industry under study. The group project method permits students actually to engage in role-playing activities. Each class formulates its own ideas on project design. Committees are established, and role-playing assignments are chosen democratically. The group project is a class function and offers the students an opportunity to express themselves collectively.

The mass production approach exemplifies the "American way" of manufacturing products. The establishment of a company, the sale of stock, the manufacturing of a product, and the sale of the product to obtain a profit are important activities in which students are actively engaged. Product design and the necessary jigs and fixtures to build the product must be student-designed.

The individual project is used as a means of self-expression and permits the student to make a project of his own choosing. This individual project emphasizes the vocational aspect of industrial arts. Design and craftsmanship are key evaluating criteria.

The world of construction is the second course offered in the senior high school. Community development is the focal point of this program. The group project approach and the Industrial Arts Curriculum Project materials encompass the majority of the material covered in this program. Although the IACP project was designed for junior high, our preliminary experiences indicate that this program works equally well at the 9th and 10th grade senior high level. Senior high students progress faster through the experiments, leaving more time for individualized learning experiences.

At the completion of manufacturing or construction, a student may enroll in materials and research. This year-long program is totally individualized and student-centered. The student selects his research topics and develops the scientific procedures to accomplish the desired objectives.

The latest industrial arts venture in the Prince William County Schools has been the establishment of a program in communications. The communications lab offers experiences in electrical and visual communications, with the major emphasis on the communications media, such as, newspapers, books, magazines, letters, telephones, television and radio. Although the lab is equipped to teach electronics, drafting and graphic arts, teaching the unit area concept is secondary in the communications approach. Students can learn the workings of the newspaper, television and radio without actually knowing all the technical knowledge of its production. Activities are designed to acquaint them with the technical and social problems related to mass communications media.

Unit labs are offered in Prince William County in three areas: electronics, drafting and graphics. The unit concept tends to point toward a pre-vocational type of program and is often confused with vocational education. Our newest task will be to define the role of the unit lab and its relationship to industrial arts and vocational education.

New programs in power and transportation are in the developmental stage, and, with the advent of two more senior highs, this program should be a reality in the next two years. We believe our attempt to establish a relevant program in industrial arts has been very successful. If increased student and public interest in industrial arts is an effective criterion for program evaluation, then our program of relevance has succeeded.

Mr. Bonfadini is on the Prince William County School Board, Manassas, Virginia.

Relevance of industrial arts content

Thomas A. Hughes, Jr.

The title of this program certainly has capitalized on words in popular favor today. The word relevance in particular bears upon vogue English. Considered within the title of this discussion, it not only corresponds with terms used by the "in-crowd", but most importantly it denotes that a connection can be made between industrial arts content and other things.

Those things to which a discipline area can relate are society, the school, the curriculum and the learner. It may be considered that to be relevant, a discipline area must be sensitive to all the elements to which it relates. Relevance then may be considered like perfection - something to be sought and obtained by degrees but not in totality.

Expanding upon these elements and beginning with the most encompassing, let us first consider society.

Kranzberg(3), Drucker and numerous writers, many within our own field, have eloquently written about the issue that society today is distinctly and uniquely characterized as technological. It has been noted that society actually is now in a post-industrial period and that a continuously smaller percentage of the population will be engaged in industrial production. Specifically it has been predicted that in the 1980's "two or three percent of the population could do all of the work that has to be done to satisfy the material needs of society."(2)

In essence, industrial arts must relate its content to a society that is intensely becoming more technologically sophisticated.

The second major element - the school (perhaps it should be called the educational system) - is constantly concerned with some form of change because of new developments or findings in the areas of sociology, psychology, human growth and development and other areas. Likewise, as the school takes on new approaches and organizations, the specific discipline areas must be attuned to the reasons for those changes and adapt to them. For example, the discipline area content for the middle school must be aligned with the philosophy and concepts of the middle school.

Industrial arts must relate its content within the context of the contemporary educational system in which it functions.

The third element of concern in seeking relevance of content is the curriculum. The curriculum for this presentation is considered to be the entire discipline area of industrial arts. Presently there are from six to eight major curriculum projects under way across the country, according to Cochran (1), that are concerned with an innovative approach to industrial arts. (If the term industrial education can be accepted, many other projects are under way; however, the author does not accept those as industrial arts.)

These curriculum projects have been built upon contemporary findings drawn from the elements presented here. They have been researched, experimented with, implemented, evaluated and refined. Relevant industrial arts content must draw upon this research within its own field. Relevance cannot be obtained when each program exists within a realm of ideas centered around competencies of an individual teacher. Relevance in industrial arts should be achieved most efficiently when programs are founded upon the research base of these major curriculum projects.

Relevance, to the learner's interests, is the keystone of a growing program. To expand this thought, consider why the student has enrolled in a specific industrial arts course. According to the survey by Schmitt(4), the vast majority of the students taking industrial arts in the nation are enrolled on an elective basis. An elective subject must maintain a high interest level in order to survive the competition, disregarding the need for growth.

A second point concerning the learner is that he or she has developed interests while a native of a technological society. In light of the rapidity of change society is undergoing, and the technological advancements being made, the learner is the native to the society and to the sophistications of technology; whereas the teacher, supervisor, or, for that matter, any adult, is the immigrant.

These brief statements represent the thoughts behind one program of action to bring about relevance of industrial arts content.

The efforts in Virginia, which have involved the State Department of Education, began four years ago when a group of teachers, supervisors and teacher educators met to develop a basic guide for program organization and improvement.

Also at this time, a survey was initiated to determine the greatest needs of programs and teachers in the state. Very quickly it was determined that the greatest needs were curriculum guides and in-service programs.

The State Department took the position that materials developed at the State level should (1) involve a cross-section of personnel in the State, including classroom teachers, supervisors and teacher educators, (2) be developed as directional devices and not courses of study, and (3) be designed for the secondary level - grades 7-12.

During the three years that followed, numerous workshops were held on weekends to develop curriculum guides which were based upon the suggestions of the organization manual. In January, 1969 the last guide of this initial series was distributed.

As soon as the last publication became available, two problems were apparent:

(1) How were teachers going to implement these materials?
(2) Most school administrators were unaware of what a contemporary program should be.

To meet these two needs, work began to prepare a publication for school administrators, and arrangements were initiated to establish a statewide in-service program to prepare teachers to implement a relevant program.

Probably the most significant development to bring contemporary ideas into laboratory practice has been the in-service program, because this has given teachers real experiences that relate to their own responsibilities.

The content for the in-service course is based entirely upon the Maryland Plan developed at the University of Maryland, which, along with Olson's ideas, formed the base for Virginia's curriculum materials.

The in-service program is presently in operation, with nearly one-third of the teachers in the state participating in this three-semester-hour, graduate-credit, tuition-free course.

It appears that a key to making this program relevant to the teachers is that outstanding secondary teachers and not teacher educators teach the course. Four secondary industrial arts teachers and one supervisor, who have been actively involved with implementing the Maryland Plan over the past few years, are in the role of teacher educators.

How do you determine, after all of this, that the content is relevant? Perhaps some day an objective evaluation will be attempted; however, for now it appears a degree of relevance is being obtained from the following observations:

(1) Students in classes where the new content has been implemented are observably enthusiastic and excited about what they are doing.
(2) Enrollments are increasing.
(3) Teachers appear to have renewed enthusiasm for what they are doing.
(4) Administrators and supervisors are encouraged by the improvements in instruction.
(5) The public is expressing interest in what is going on, with parents requesting that their son or daughter have the opportunity to take this "new industrial arts".

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From the traditional to the "new industrial arts"

George Litman, Jr.

As the title of my presentation indicates, I plan to address my thoughts this afternoon to the supervisor's role of how we have been able to direct our staff from the traditional to the "New Industrial Arts". Five years ago, I became concerned about our fast-increasing school population and the new schools which we were constructing in Fairfax County, Virginia. It was at that time I decided and was determined to change our staff through some kind of in-service program. I knew that with all of our new facilities, air-conditioned laboratories being built and new equipment being purchased, this alone would not change the program.

The traditional industrial arts program of yesterday was structured around individual student projects and, in many instances, the selection of a project was made by the instructor. This approach did not allow for individual student talents, abilities and interests, even though it did permit students to develop concepts of industrial materials, processes, tools and machines. Unfortunately, the teacher made all the decisions, and the program varied from one school to another.

The "New Industrial Arts" programs are designed to prepare youth for more effective living in a technological society. They are considered part of general education since they derive their content from technology - its evolution, utilization and significance; and from industry - its organization, materials, occupations, tools and products; and since they deal with the problems and benefits resulting from the technological and industrial nature of society. The industrial arts laboratory presents an area of learning found in no other place in the school.

In Fairfax County, the move away from the traditional program began when fourteen industrial arts teachers, in 1965, enrolled in a workshop entitled "New Methods of Teaching Industrial Arts", at the University of Maryland. The workshop was characterized by "learning by doing", with a focus on program development in industrial arts. Based on the structure and concepts associated with national trends in industrial arts education, it emphasized three important aspects of teacher education: appropriate content for the 7th, 8th and 9th grades; appropriate methodology for these grades; appropriate activities - in which teachers in the workshop were actually involved - for carrying out the various aspects of the program.

Initial phases of the workshop spelled out the four-point philosophy of this approach:

--implementation of the definition of industrial arts
--emphasis on students, rather than on projects
--utilization of psychological principles and understandings in program development
--development of individual resourcefulness, problem-solving ability, and inquiry.

In the fall semester of 1966, the fourteen industrial arts teachers who had been involved in the workshop began to implement "New Methods of Teaching Industrial Arts" in their own classes. An introduction to the new approach used films, transparencies, lecture and discussion to develop understanding of industry's automation, financial structure, labor-management relations, occupations, materials, processes, productivity, tools and machines.

Programs at each of the three grade levels took a different direction. The seventh grade's was based on an anthropological study of the basic elements common to mankind and included the development of tools and machines, power and energy, communications and transportation, and the contribution of each of these factors to the growth of civilization.

It was decided that the anthropological study could best be accomplished by the unit approach centered around an interest point. Each student chose a sub-topic, out of the various integral parts which made up the total study, for his special responsibility. He then gathered texts, pamphlets and other materials from libraries, institutes, industries and specialists in the field and reported back to the class in a seminar. In this way, each student became a specialist on his own sub-topic and profited from exposure to every other sub-topic as well.

As the research was being compiled, a model was constructed, involving the students in the use of tools and machines and in sketches, materials and processes. The models involved working parts and were as nearly authentic as possible. In conjunction with the model, the students also prepared a display board, which effectively communicated a historical or cultural era, using dates, events, cartoons, graphics and comics.

In this program, each student was given the opportunity to perform at his maximum ability and to display his specific talent. Evaluation was made of student gains rather than of the smoothness, completeness and attractiveness of some project.

At the eighth-grade level, a group approach was applied to the study of an American industry. The program's purpose was to provide an understanding of a major industry through an in-depth study which would also lend an appreciation of modern technology and its impact on a continually-developing industrialized democracy.

The group project involved students in organizing, researching, planning, creating, inquiring, analyzing, evaluating and constructing a group project which correlates recognizable facets of a modern American industry. As part of the project, a panel display made of individually-built component parts was constructed as one means of depicting the industry.

To select a contemporary industry, a list of industries was drawn up by the class. The list included lumber, concrete, steel, aluminum, copper, plastics, foundry, glass, automobile, paper, aircraft, shipbuilding, rocketry and house construction. Introductory lectures and films provided the background for selection of an industry, and the class then assumed a group project responsibility. A personnel system was established, giving each student a role comparable to that in a major industry. Personnel and job descriptions were as follows:

Project Coordinator - in charge of the group project. Should have leadership ability and be able to develop a sequence of operation such as the steps employed in construction of the display.

Design Engineer - established the overall design and specifications of the group project display. Would specify everything from the number of nails and screws needed to the painting and final assembly.

Research Director - coordinates the collection of all information necessary to construct the display.

Education Director - informs employees of policy. Explains the process from raw materials to finished product to shipment, using films, books, pamphlets, charts, illustrations, diagrams, etc.

Financial Director - designs forms for use in purchasing materials needed for the display and obtains sample forms used by the industry under study.

Personnel Director - creates jobs, chooses persons to fill the necessary jobs, makes a personnel flow chart relevant to the industry under study.

Safety Engineer - creates awareness of safety precautions, establishes an atmosphere of safe working conditions, gives safety talks, lectures and prepares posters appropriate for the industry under study.

Public Relations Director - greets visitors to the laboratory, makes formal introductions, and explains the work under way in the classroom.

Other personnel could include: Historian; Electrical Engineer; Record Officer (secretary or accountant); Production Foreman; Steward; Tool Foreman; Finishing Foreman.

In a once-a-week seminar, the students exchanged ideas and communicated by role playing. At the same time, progress on the individual modules proceeded to the point of assembly into a panel. The panel was completed through group work sessions and ready for evaluation and display.

Evidence indicates that these experiences provided an interpretation and understanding of the industry studied as well as opportunities for students to "explore" on their own rather than to be exposed to a series of "canned" experiences set forth by a teacher.

The ninth-grade program used a line-production approach in which students undertook an in-depth study of mass-production industry. Simulation of the industry provided experiences in organizing, financing, product determination, tooling-up, production, packaging, distribution and personnel role-playing.

In this program, each student applied for the position of his choice and was interviewed by the student playing the role of Personnel Director of the company.

Unlike the personnel system used in the eighth-grade program, which centered around a product similar to those produced by research and development industries, positions assumed in the ninth grade's study of a mass production industry were concerned with volume production of identical items.

This semester there are twenty-four industrial arts teachers involved in a course with emphasis on appropriate content for the 10th, 11th and 12th grades. The methods include a contemporary unit, group project, research and experimentation, line production and problem solving. Some of the teachers enrolled are already implementing several of these approaches, and the results are phenomenal.

Since 1965 three additional groups of Fairfax County teachers have attended a workshop on "The New Methods of Teaching Industrial Arts". As of April, 1970, fifty-two percent of the county's industrial arts teachers have been involved in such a course.

Today industrial arts teachers throughout the county school system, at the intermediate and secondary levels, are approaching the study of technology and industry through the individual project, anthropological and contemporary unit, group, line production, research and experimentation, and problem solving. Such approaches provide a laboratory activity and a study of technology and industry which prepare students for today's and tomorrow's technological society.

Mr. Litman is Supervisor of Industrial Arts Education for the Fairfax (Virginia) County Schools.

Relevance of industrial arts content (a report on in-service training)

Mark Delp

As John Bonfadini has already outlined for you, we are trying to teach the "New Industrial Arts" in Prince William County. Often when I give a presentation on what we are doing and trying to do, I find myself on the defensive because of people who resist and fear change. Let me begin then by briefly trying to justify the "New Industrial Arts" from a teacher's viewpoint.

After giving a slide presentation to the Virginia Industrial Arts Association last summer on what we were doing at Gar-Field High School and in Prince William County, the other members of a panel and I were subjected to a question-and-answer period. One of the first questions was directed to me by a very dedicated but puzzled teacher. He asked me if I wasn't for change just for change's sake. I could not help replying that I was. And I will repeat that I am still for change for change's sake. The world around us is changing every day, and each day more rapidly than the last. It is for the sake of this change that we must change or become extinct as a profession. If we are to teach contemporary industry, we must change as it changes and in such a way as to continually change. The traditional industrial arts of making bookends and sugar scoops was excellent when that was the stage industry was in. The industrial need for a craftsman to make a complete chair or to make any item from beginning to end is very low. There is, however, a definite need for people who understand industry and how it operates; for people who can determine where they might fit into this industrially-oriented society of ours to its and their best advantage. I believe the "New Industrial Arts" can bring this about to a much greater degree than the traditionally-oriented program. Teaching, however much we would like to disavow it, is like many other things in one respect. It is a matter of percentages. You are never going to get to everybody all of the time, but when you stop hunting ways to get to more people more beneficially, you are stagnant and of very limited use to your students. To be of benefit today, we must teach contemporary industry in an effective way.

When do students learn? They learn when they are interested. They are interested when they think or know what they are learning is relevant and when teachers aren't trying to talk it into them. Students learn by doing.

We say students learn by doing, and that's primarily what I am here to talk to you about today. In Prince William County, Virginia, last semester, the teachers became students for a while, and there was a lot of 'doing' going on. A three-hour graduate credit course was set up with Virginia State College called New Curriculum Trends in Industrial Arts. It was offered, free of charge, to industrial arts teachers in Prince William County and was taught by Mr. George Litman, Supervisor of Industrial Arts Education for Fairfax County, one of our neighboring counties. John Bonfadini, our supervisor, took the course right along with the rest of us.

We studied three contemporary methodologies during the sequence of our course. We started out with the Unit Method. Using this method, we employed both the anthropological approach and the contemporary approach. After studying the unit we went into the Group Project approach and after this ended up studying Line Production. During the course, we were expected to do exactly what we would expect our own students to do. There was a difference in the level of work, of course. I can't think of anything that gives you more insight into what students feel than actually being one again.

The teachers taking our course were made up of both junior high and senior high teachers. Since we felt that the application of the different approaches would vary for the different grade levels, we used this means to separate the group, which was twenty-seven strong. In the study of the Unit Method, the junior high teachers used the anthropological unit approach; whereas the senior high teachers used the contemporary unit approach, or from 1800 up to the present. In the Unit Method approach, the major emphasis is on researching, planning and constructing. A written report and a seminar report are also required of the student using this approach.

During the study of the Group approach, the junior high teachers did a Group Industries Study of the plastics industry and the senior high teachers used the Group Project approach to study the construction industry, gearing it toward community development. In the Group Project approach, much emphasis is placed on personnel organization and role playing.

During our study of the Line Production approach, the emphasis was again on personnel organization and role playing. Both the junior high and senior high teachers designed a product, and each acted as part of the others' labor force.

Do these methods sound like proper vehicles to teach contemporary industry in an effective way? I believe they do. They are not the only effective ways, I am sure, and more ways are being found all the time. Likewise, all methods won't work equally well with all teachers nor with all students, but the more tools we have at hand, the better the job we are capable of doing and are likely to do.

As with anything else, you must believe in what you are doing. I believe in the "New Industrial Arts". I believe it will work for my students. If it works for them, needless to say, it has worked for me.

I enjoyed the in-service course that we had in Prince William County. Few of the teachers involved had any prior teacher education on these new methods other than that which was county-sponsored. I think the results of the course were excellent. This is shown both by the work that the teachers put into the course and also by the teaching that is going on in the county at this time.

Industrial arts teachers do not need to fear change. What should be feared is the possibility that the profession and the teachers will not receive the incentive to change.

Mr. Delp teaches at Gar-Field High School, Manassas, Virginia.

Design and implementation of statewide programs for industrial arts

Ralph V. Steeb

The responsibility for designing and implementing a statewide program for industrial arts rests in the office of the state consultant. Now that 40 of the states have created this position, leadership for curriculum development, which in the past was missing in many states, can now be centralized in the state office. A state consultant, by nature of his position, is recognized within a state as a leader and an authority in his special subject field. School district administrators and teachers look to the state office for direction and help. Because of this reliance and faith in the authority of the state personnel to stimulate and create better learning experiences, consultants must be certain that any program which they propose is based on sound philosophical and educational foundations and on the best human relations techniques.

A state consultant must serve in the role of:

(1) A liaison person between the state agency and local districts. He is in the middle and is the communication link and program catalyst. His activities and pronouncements must reflect the state's objectives and philosophy and at the same time respect the local district's objectives and philosophy.

(2) An expert in the special subject field. The state leader must be a most knowledgeable person about curriculum, in identifying problems, and in understanding the individuals with whom he must work.

(3) A change agent. The state consultant's role is to identify problems and proceed to help local persons find their own solutions. He stimulates change based on identified need. As a change agent he will set up experiences, including meetings and visitations, which may change the concepts or understandings of the individuals with whom he is working. Often he must first stimulate discontentment with what exists in order to create a desire for change. Having created the desire, he will then take the responsibility for re-establishing stability through a change program. And finally he must take steps to insure the permanence of the change.

In these roles the state consultant may operate: (1) passively, by suggesting, pointing out, distributing, questioning and discussing, not making unilateral decisions but involving others, avoiding conflict which might jeopardize his involvement and leadership position; (2) actively, by displaying organizational leadership, synthesizing, making suggestions, and answering questions directly. Knowing when to assume these various roles is a key to successful human relations.

In designing and implementing a statewide program, the state consultant has certain factors to consider, guidelines to follow, and responsibilities to organize and carry out.

It must be recognized that statewide implementation of a new approach will require the efforts of many people (one person cannot carry the program alone, for an imposed program is doomed to failure), the expenditure of a substantial amount of time (both from the consultant's schedule and on the part of personnel in the state), and funding (for planning, dissemination and the process of implementation).

Curriculum development in Florida is based on five assumptions as follows:

(1) The ideal unit for curriculum development in its specific and detailed aspects is an individual school faculty operating under the leadership of the school principal. This recognizes the fact that no two schools are exactly alike. Since individual schools differ, curriculum adaptations must be made in a particular school and in each classroom within the school.

(2) Since many common problems, conditions and needs exist in any local school system, there are many aspects of curriculum development which can be worked out most satisfactorily for the local school system as a whole.

(3) By taking this one step further, we bring the state into the picture. We recognize that some of these problems, conditions and needs are common to the entire state and can, therefore, be attacked on a statewide basis. It is, therefore, desirable to have a broad general curriculum framework developed at the state level. Within this framework, local school systems and individual schools are encouraged to develop specific programs most appropriate to their situations. When requested, consultation services are provided by the Department of Education to assist with local development.

(4) Changing the curriculum means changing people. Processes used in development of

curriculum materials and content should not only provide useful materials but should also provide for professional growth of those engaged in the process. People understand better and tend to support with conviction those decisions they have helped to make.
(5) Since the direct administration and supervision of individual schools are local functions, the Department of Education should work with and through local leadership and should be active in the discovery and development of educational leadership at all levels.

In Florida, the preparation of curriculum guides has been one of the major activities designed and worked at continuously to promote the professional growth of educational personnel throughout the State. This medium has been the chief vehicle through which the problems of curriculum development in Florida have been attacked. A new curriculum guide for industrial arts has been published by the Department of Education in each of the last four decades. Many others have been developed by local school systems.

State level curriculum activities attempt to identify those problems, conditions and needs which are common throughout the state and provide helpful suggestions and recommendations to local schools. Curriculum guides developed for statewide use are not "courses of study" in the usual sense. They are neither detailed nor prescriptive. They are, as the name implies, "guides" rather than directives.

There are, of course, certain minimum standards and regulations relating to curriculum laid down at the state level by state laws and State Board of Education regulations. Within a broad and general framework established at the state level, local schools are expected to develop in specific detail a program of learning experiences "tailor-made" for their youngsters. Within the more specific framework thus provided at the local school level, individual schools and individual teachers work out the day-by-day learning experiences most appropriate for their youngsters.

Certain machinery has been set up for curriculum development in Florida. At the state level, for example, there is a statewide curriculum committee, established by law, known as the "Florida Courses of Study Committee". This committee formulates immediate and long-range plans for statewide curriculum projects, recommends the preparation of curriculum guides, and recommends instructional materials and resources for state purchase. Members of this committee review and recommend to the State Board of Education curriculum materials designed for statewide use. Through the Courses of Study Committee are channeled suggestions from school and lay people for promoting desirable statewide curriculum programs and practices.

Earlier curriculum guides in industrial arts were developed through the assistance of professors and graduate students in curriculum courses held during the summer at the state universities. Teachers, supervisors, Department of Education personnel, and college and university staff members participated in these workshops. Those who desired it could usually secure college credit for participation in the workshops.

While the bulletin production workshop continues to be utilized to some extent, other procedures, especially appointed state guide committees, and special conferences, have been tried with increasing success in recent years in order to secure a larger degree of participation.

At the present time there is a state curriculum guide in the process of development. This activity was preceded by a two-year period of orientation and consolidation of opinions on new approaches by industrial arts personnel statewide.

The easiest way to initiate a statewide program is merely to publish a new state bulletin and mail it to all teachers in the state. But such documents end up on dust-covered bookshelves because teacher involvement was minimal.

The following are some factors to consider which may be obstacles in the path of the program implementor:
(1) Teachers are reluctant to begin instructional programs with which they are not familiar. That which is new and unfamiliar is often resisted.
(2) Teachers are consumed by the relentless requirements of daily preparation for routine tasks. Implementation of a program must start outside the individual teacher laboratory. Teachers must be involved and provided with teaching materials and general guides.
(3) Frequently our learned leaders in curriculum development present excellent rationales, philosophies and position papers, but few translate these into classroom or laboratory methods. Thus, examples of logically-organized programs have been with us for several years but have never been implemented.
(4) There is no national organization or commission attempting to codify or summarize new curriculum ideas or programs. Each new curriculum approach is operating separately.

This separate approach, it seems to me, is an obstacle which must be overcome by state level coordination. It isn't, in my opinion, wise to use only one plan, such as the Ohio, Stout or Maryland plan. The various curriculum plans and ideas available must be classified, coordinated and packaged for teacher use. The National Industrial Arts Commission has failed to function thus far. Thus states must take up the task, for this is the proper and most effective level, when all factors are considered.

(5) Industrial arts teachers are not trained to implement new approaches. Teachers are still project-oriented rather than problem-oriented. All supervisors who attempt to employ teachers capable of teaching the newer approaches know the difficulty in locating such persons. Woodworking and drafting teachers are still far more easily obtained.

(6) New approaches and ideas are often part of the national conference programs, but frequently state and local industrial arts programs continue to place emphasis on skill demonstrations and limit activities in the area of curriculum development.

In looking forward to curriculum innovation and implementation, state consultants must also consider:

(1) The history of curriculum change in the individual state. If programs have been traditional with little or no innovation or if programs have been open to curriculum experimentation, the state supervisor must consider this prior history in his planning.

(2) The experience or inexperience of the industrial arts personnel in curriculum development methods will affect the organizational plan.

(3) The identification of leaders must be considered to determine who can effect change. The key personnel of this state should be evaluated by the state consultant to determine their effectiveness and best way to utilize their abilities.

(4) Recognition must be given to the fact that designing and implementing a statewide program is a continuous process. There is no quick route to successful change.

The need for developing a statewide program of industrial arts is apparent:

(1) There is no single sequence of courses for industrial arts within states or across the country. One can find a variety of curriculum patterns and projects being attempted, while for the most part the program remains traditional.

(2) Lay persons, legislators and other educators do not understand the philosophy or role of industrial arts. Yet the public and legislators are the persons who support our schools and to a large extent control programs through financial support.

(3) Industrial arts programs, in general, remain a static and comfortable group of subjects where pupils build take-home projects such as leather wallets, footstools and bookends, or draw endless plates copied from abstract objects in a textbook. Programs continue oblivious of the change taking place outside the school. It is true that industrial arts personnel speak fluently about the changing world, but the vast majority of our laboratory instruction is the same as it was in the 1920's. While we react and are stimulated to hear about the changing world, we soon after fall back into the common human nature trap of perpetuating our old patterns and programs.

Only a statewide program of total involvement can effectively design and implement programs which move off the immobility of dead center and take a position on the dynamic perimeter where education is moving.

The sequence of steps which may be taken by a state consultant are:

(1) Initiate the program and define what should be accomplished: First determine and express the need for a statewide program; goals should be formulated and procedures proposed. Curriculum reforms should be presented. Thus the personnel of the state would receive an initial orientation to the need and proposed directions. Materials, special projects and meetings will assist as supporting activities at this step.

(2) Regulate the progress: The state consultant should determine the thrust or direction, identify the type and composition of groups, and set and control the pace of the deliberations (time limits and deadlines). Avoid the impulse and pressure to move too rapidly for the group.

(3) Provide information: Bring new information or research findings to the group. Classify and adapt materials which are available. Secure consulting specialists. Organize to provide instructional materials for the modified programs. Disseminate information through newsletters, conferences and workshops. Broaden the horizon of teachers so they may be prepared to discuss and consider new approaches realistically and intelligently. Cover all personnel in the state and do not work with one committee or one group only. Teachers, supervisors and teacher educators all should be involved. It is especially important to work with teacher educators to provide them with an awareness of the state direction. Such information will then find its way into the courses and extension classes

taught by teacher educators and help to broaden general understanding in the state. By providing information you assist in convincing all personnel in the state of the value of the state program.

(4) Support the groups and individuals in their activities: The state consultant should encourage and support all activities related to expanding the knowledge and interpretation of the program. It is vital to build inter-group rapport. Methods of facilitating individual contributions should be used. Meetings and contacts should use open informality with respect for the opinions of all. Group activity should be enhanced by keeping the group as a united whole and avoiding splinter factions.

(5) Evaluate progress: Periodically evaluate the progress in program development and redirect activity if needed. Help the working groups to evaluate their own work. Use group consensus as a basis for further action.

(6) Field tests: Pilot and experimental programs should be established to test the program before final conclusions or documents are made.

(7) Evaluate the pilot programs: Evaluation of the pilot programs and the materials prepared will lead to a revision of the program and to its final acceptance.

(8) Implementation: The state consultant has a responsibility after all former steps have been taken to promote the implementation of the program as a state-adopted plan.

The following are guidelines to facilitate the implementation of a statewide program:

(1) Start with a nucleus of industrial arts leaders. These may be district supervisors or teacher educators. Test their reactions and assessment of the program. Seek to gain their endorsement before proceeding. Then broaden the participation with each succeeding activity or meeting until all personnel have been apprised of the program.

(2) Do not underestimate the importance of teacher educators. It is vital that they be informed of your program and plans and, in the very small teacher education programs, that they be kept up to date on curriculum trends. Teacher educators have the ability and time to spend on creative, reflective thinking in comparison to the classroom teachers. The effect of teacher educators is far-reaching, since they teach in-service teachers either in graduate or extension classes. Teacher educators frequently are speakers at industrial arts meetings where they can set forth the concepts of the new program. Considerable assistance in promoting a program can be obtained if the teacher educators would assign their students experimental problems and classroom research rather than sterile term papers.

(3) Make certain that all supervisors are acquainted with the program before extending the information to teachers. Supervisors must be able to answer questions raised by teachers.

(4) Make every effort to secure adequate budgets. Group meetings, whether at state or local level, are greatly facilitated when funds are available. Explore all sources: Federal, state and local. Funds are imperative if a statewide meeting is planned.

(5) Encourage school districts to employ the most capable teachers available. In view of the teacher shortage, school districts which offer the most attractive program and facilities will attract the better teachers. Some screening of teachers is then possible. One of the most desired school districts in the country achieved this position in a very few years by first establishing an exemplary program and then completely equipping it.

(6) Wide exposure of the state plan is vital. State consultants should use the state conference for teachers and a variety of publication releases to report information and progress.

(7) The exposure of industrial arts personnel to the statewide program should be frequent. This is especially important when introducing a new approach. Experience has shown that teachers must participate and hear the plan or idea at least four times before they begin to accept it. The exposures should occur at different times throughout the year. Open communication by many means must be maintained. Conferences, workshops and dynamic group meetings should be scheduled. Speaker-type meetings should be discouraged and be replaced by meetings which permit teachers to take an active role. It is more important to use consulting personnel who have tried new approaches than to use a philosophical speaker.

(8) Maintain close cooperation with local personnel either through the district supervisor where employed, or through the principal and teachers in small districts.

(9) To implement new programs, use a variety of ways of working with people. Certain techniques include releasing the teachers one half-day per month to attend curriculum meetings; using teachers as leaders to present new materials; having fewer lecture meetings and more discussion, work session and small-group activity; pay the teachers for extra time beyond the school day (example: Florida Educational Expense Funds).

(10) In designing a statewide program be certain of your understanding of pupils in today's schools. A knowledge of practical psychology of youth and of social and economic conditions is most helpful.

(11) At all times be flexible. Often meetings must be adjusted to conditions which arise due to the individual differences in background, experience and initiative of the participants. There is no one best way to proceed.

(12) In working with local personnel be as practical in your approach as possible. While philosophical foundations are important, local personnel need specific information. It is important to emphasize that new programs teach how to learn rather than what to learn, that teaching techniques should begin with concepts, principles, theories and ideas instead of separate material processes. When setting forth a new program, the beginning point is the need or problem which when agreed upon makes further planning easier due to unity of purpose. Setting forth a statewide program should be looked upon as searching for solutions or expressions which solve problems.

In Florida a new curriculum approach for industrial arts has received almost total acceptance because of the utilization of the principles which have been previously listed. The new statewide program began with a concern over the overwhelming number of traditional teaching situations and the poor quality of student outcomes. The need was specifically identified through two or three county surveys of industrial arts. During one survey the existing industrial arts program was found to be so lacking that an entirely new philosophy and sequence was designed and recommended to the district. This philosophical base became the foundation for a new state program. The information was disseminated first to the Florida Industrial Arts Advisory Committee. With the committee's endorsement the program was then presented to the conference of industrial arts supervisors and teacher educators. Communication regarding the program was then broadly disseminated to teachers at the state industrial arts conference and at five regional teacher meetings. The time expended to this point was approximately one and one-half years. A major hurdle was cleared when requested funds were approved to hold a curriculum workshop for the preparation of a bulletin describing the state program. This workshop met for three and one-half days with four out-of-state consultants. At the workshop supervisors, teacher educators and teachers reached consensus on commonalities of the various curriculum approaches being explored across the country. A 59-page interim bulletin resulted. This bulletin was again the basis of a presentation for the following state conference. The demand for the bulletin was extensive and copies were soon exhausted. The continuing implementation of the program now took the form of planning activities with school districts for the preparation of educational specifications for new industrial arts programs and the wide distribution of information about the program in the state industrial arts newsletter and a special brochure prepared for school administrators. By proceeding at an orderly, persistent, steady pace geared to the ability of the various personnel in the state to assimilate the program favorably, very little resistance or reluctance was experienced.

It is our experience that to achieve progress, leadership for program development must originate in the office of the state consultant.

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Discussion panel—design and implementation of statewide programs

Carl W. Butler

My presentation this afternoon will be twofold: Number One - a brief overview of curriculum innovations in the State of Maine; and, Number Two - implementation and warning signals for curriculum innovations. We must ask ourselves what the schools should be doing to benefit the individual and, thereby, benefit total society. What the schools should be doing is, of course, a curriculum question – and this leads us into my presentation – The Maine State Plan ("Industrial Arts Technology - A Study of American Industry").

The curriculum in the State of Maine is based upon the broad industrial classifications of manufacturing, construction, power, transportation, electricity-electronics and service. These units have been made functional and occupational through the unit method of organization and instruction. When we hear the word "unit", we think of many different things--from a unit in machine work to a unit shop. Let me define the unit as a means of organizing instructional activities and materials into large related and unified patterns of learning with Maine educational objectives that will meet the needs of our youngsters and benefit the total society. Through the unit method, the work of one semester of the year is divided into a series of interrelated flexible plans, each having a unifying element or central theme towards which the activities or learning experiences are directed. In the laboratory of industry, the unit cuts across the arbitrary dividing lines which usually exist between subject areas, reduces to a minimum the piecemeal learning of unrelated isolated skills or facts, and provides learning experience through which the slow learner will find himself and the most gifted will be challenged.

Before explaining a typical unit, I should tell you that Maine's industrial arts facilities have three basic designs. In the larger cities, many schools have unit shops: a unit for metal, a unit for wood, etc. The smaller schools have a one-man industrial arts facility on the general shop concept. Probably the most common facility is the two-man general shop, which is of particular interest to us at this time. We felt that if industrial arts were to observe the exploratory functions for a sound industrial arts program, more than one single area of work should be included in the curriculum. If we were to study not only material and processes but the management of an industry as well as the material and processes, a different approach was needed.

A guide for secondary schools ("Industrial Arts Technology - A Study of American Industry") was developed in 1965. Gorham State College of the University of Maine and the State Department of Education cooperated in the venture, which involved many teachers in an in-depth curriculum study. This project was spurred on by the acceptance of the unit method in both junior high schools and senior high schools in Maine. To further promote and evaluate the unit method, an NDEA Institute was proposed and held at Gorham under the direction of Dr. John Mitchell. This institute concerned itself primarily with junior high school students and with the study of the manufacturing industries. Twenty general industrial arts teachers representing 14 states from Maine to California participated in this institute. Although our curriculum guide had been in use in Maine for approximately four years, many veteran teachers were not aware of all the concepts presented in it. During the first two weeks of the institute, the teachers were oriented to newer educational developments, teaching methods and unit organization. They were then divided into four teaching teams, each of which prepared a unit entitled "Introduction to Technology in Industrial Arts". These units were to be used and evaluated during the three weeks of in-depth study which followed. Sixty boys and girls, students in the Gorham town schools, were to enroll in grades 7, 8 and 9 of the experimental NDEA institute. They were volunteers with no prior experience in industrial arts. The classes met for an hour and twenty minutes daily or the equivalent of three 40-minute periods per week for 15 weeks. Major portions of each class were video-taped to provide proper evaluation. At the conclusion of the institute, each unit selected was a complete teaching package, containing purposes, pupil activities, approaches, instructional resources--including references, instructional aids and devices--suggested lessons, lesson content and a final unit evaluation.

The title of each unit was based upon student interest and representative manufacturing industries. The basic concepts of the functions of the manufacturing industries studied were personnel management, engineering, production, finance and marketing.

If we are truly to study the ways of industry, we must study areas other than production. Let us consider a typical unit. We'll call it the camping equipment industries. This unit should provide some idea of how areas such as woods, metals and plastics can be a total part of the manufacturing industries in a school shop situation. These units are interrelated, can be flexible and, most important, can cut across the arbitrary dividing lines which usually exist between subject areas. This unit method will reduce and minimize the piecemeal learning that usually occurs when one studies a unit of woods, then plastics and metals without showing the relationship of measuring tools, cutting tools, and the total picture of how a product is made. It is true that the more gifted child may find himself more involved in developing the product, while the slower student may be more concerned with the manufacturing of the same product, but this is also true in life. People learn to find their interests and aptitudes by being involved. This gives a youngster an opportunity to realize his abilities and limitations under a controlled situation, without the embarrassment of failure. Through the various activities in this type of unit, each youngster should find a place where he can develop, expand and test his individual talents. The camping equipment unit is only one of many different units within the laboratory of industry, but it gives pupils the opportunity to develop a profitable use of their leisure time while they acquire other basic concepts. Since many American families have become campers, the camping equipment industries have had an increase in the demand for their products. Pupils are usually enthusiastic about units closely related to their daily living and are highly motivated to study the manufacturing activities that are associated with the development of a camping equipment unit. The unique plan in this type of unit is development around the student's opportunity to see the organization and structure of the cooperation involved in mass production of goods or other methods used by industry. They may gain only the basic tool skills necessary to develop and produce a simple product by mass production or other methods of producing goods, as major emphasis of the unit will be on basic understanding of the functions of the various elements of the corporate mass production industries. The activities carried on will be mainly motivational so that the student starts new units, eager to develop further the knowledge and skills gained from these units and acquire new skills.

If one were to understand the previously-mentioned unit of work, he would also have to know what the objectives were for such a program.

Objective I - to develop an understanding of the manufacturing industries and the role they play in our society.

Objective II - to discover and develop a degree of skill in the elements of the manufacturing industries.

Objective III - to develop desirable attitudes about his place in an industrial technical society.

Using this particular unit as a basic example, you should recognize that any industry using a similar organizational pattern could be substituted as a motivational factor. This particular unit could have used woods and metals, woods and plastics, etc. The pupil may be given an overview of the basic organization and functions of the mass production industries through lectures, discussions, audio-visual aids, motion pictures, demonstrations and other experiences for direct and purposeful understanding.

I mentioned that my presentation would be twofold. I have completed the basic explanation of the unit method and have pointed out some elements of implementation of the Maine State Plan. However, it is obvious that any time a new curriculum is developed there will be problems. The second part of this presentation will deal with some of these problems. The success of any curriculum innovation rests in large measure upon the attitudes of those charged with its implementation. Recent graduates from our teachers' college in Gorham have a good understanding of the unit method of industrial arts technology. New industrial arts laboratories are being designed specifically to implement the new plan. This plan can be implemented in the existing comprehensive general shop. This method of teaching industrial arts has forced the reluctant teacher to seek assistance from the State Guide or to turn to workshops and courses provided at Gorham or by the State Department of Education. Let me list some questions that must be answered. First, what questions will have to be answered concerning the students?

(1) Can students read and understand this information?
(2) Is there an appropriate amount of in-class and out-of-class work?
(3) Can students perform the motor tasks required by the program?
(4) Are illustrations and examples meaningful to students?
(5) Is there feeling of accomplishment from the program?
(6) Are students interested in this method or approach?

Secondly, we must look at the characteristics that are needed by teachers.

(1) Is there a need for in-service training in the unit method of instruction?
(2) What new knowledge will the industrial arts teacher need to teach the course?
(3) What new methods are included in the program?
(4) Are the teachers interested in and enthusiastic about this innovation?
(5) Are instructional materials available?
(6) Are consultant services available?
(7) Is there a guide for the teachers to follow?
(8) Is teacher preparation, both pre-service and in-service, available?
(9) Is there a drastic change in facilities that will necessitate new facilities and tremendous cost?

These are but a few questions that one should ask when contemplating curriculum innovations of any type. In answering these questions after I have observed the unit method in action, I feel much in-service training needs to be done. However, this method of curriculum organization, when understood and taught correctly, has the needed flexibility for implementation and will lay an excellent foundation for student success.

One of the assets of the unit method is its adaptability to new innovations of instruction of today's technology, such as: program text, team teaching, modular scheduling, para-professionals, large- and small-group instruction, etc. The unit approach also has the flexibility of stimulating and revitalizing a tired course of study and brings together all similar areas, such as, plastics, woods and metals, where the same measuring tools and the same cutting tools can be integrated into one lesson. It is adaptable to industrial arts curriculum in any local, any state program, and, if properly developed and conducted, will lay an excellent foundation for post-secondary education or provide students with employment skills at an entry level.

In closing, may I say that it is not my intention to jump on the bandwagon for curriculum innovations. However, it must be apparent that I believe strongly in the unit method approach to curriculum organization. If this presentation has made you aware or has given you the desire to explore this method in greater detail, then our time here will have been well spent.

Mr. Butler is Consultant for Industrial Arts and Coordinator for Vocational Programs for the Disadvantaged in the State of Maine.

Statewide programs in industrial arts

Jarvis Baillargeon

Supervisory role. In order to understand the implications of a statewide program in industrial arts, we first will have to examine briefly the role of the state supervisor. Referring to history, it would seem that supervisors come in two types, one the 'inspector' and one the 'consultant'.

The state inspector would have a supervisory role of implementing state and Federal laws. This may mean inspection trips to local schools to determine that eye safety laws, machine safety laws, education law, building codes, etc., meet minimum specifications. This type of supervision would be confirmed by a return letter to a chief school officer indicating the manner in which these deficiencies might be remedied and suggesting a later date for another visit. Another function of the inspectorial role would be the examination of written proposals for the spending of state or Federal money to see that they meet an approvable format so that a grant of money might be made. This would be followed by a visit to the location essentially checking on whether this money had been spent in the manner stated in the proposal.

The state consultant role, on the other hand, approaches the visit to the local school on the basis of "what can I do to help to improve your program of instruction?". Regardless of the present level of the program, "how can it be made better?". In most cases this type of supervision turns first to the schedule of courses offered in the local schools, to see what local initiative has done to meet the needs of the local student population. This also requires a check of class sizes, class numbers, teacher load and the quality of instruction. A supervisor would normally talk to the teachers, the principal, the guidance counselors and, hopefully, the chief school officer, trying to relate to each of them, first his observations and secondly his recommendations for improvement.

Protocol is important in helping to establish rapport with the personalities in the local school system, so important that if it is negative or partly negative the recommendations that might be made will have little value. Let me stress this. Unless the state supervisor establishes positive rapport with the personnel in the local school, he is unlikely to have substantial impact on the program. Each type of supervision is usually preceded by an appropriate letter of intention to visit on a given date and the general practices that the supervisor would like to observe.

Supervisory relationships. The supervisory relationship with the building principal necessitates evidence of the state supervisor's sincere interest in a program calculated to serve the best interests of that particular district. Here the supervisor must toe a very careful line between recommending the impossible, recommending the probable, or passing conversation about the time of day.

The relationship with the teachers must be on a friendly but correct status. The teacher is well aware that you are there to observe, to check his daily planbook, his tests, and in general to assess the quality of instruction that he offers. It does little good to smile, kid him along and figure on 'dropping the hatchet' in the supervisory letter. Regardless of the quality of your recommendations to the chief school officer and the building principal, it is the teacher who must implement instruction, and his good will is necessary for it to be done well. By far the best procedure is to observe, analyze, consider the options, then talk to the teacher about the major points that you might report in your follow-up letter. This will alert him to the direction of your thinking, give him time to consider possibilities for change, alert him to a future talk with his principal, at which time he can be ready to report that you had discussed these matters with him and that he had already implemented some of the recommendations. This gives the teacher status with the principal, time to readjust his own thinking and promotes good will with the administrative staff. All of these things relate directly to producing an improved program of instruction, which is the primary purpose of state supervision.

This relationship with the local district extends beyond the teacher, the principal and the chief school officer. In fact it extends directly to the Board of Education. One of the requirements of a complete supervisory visit is the writing of a follow-up or summary letter to the chief school officer. Though this practice may vary in different states, in general, improvement in the instructional program extends from contact with the top level person, through administrative staff, to the teacher. A follow-up letter that goes directly to the teacher, bypassing the chief school officer and the administration, has little chance of being effective.

The group which provides the money, the Board of Education, has a stake in the recommendations of the state supervisor. In many cases the follow-up letter to the chief school officer is reported in a Board of Education meeting and gives the chief school officer a lever to promote improved programs, which may cost additional money. The follow-up letter then must be directed not only to the person in the top chair, but to the members of the Board of Education as well. And let me stress this point also: This letter must be well-written, carefully "Englished", clear and reasonably concise. A busy chief school officer does not need a poorly-written sermon from the state supervisor.

Model programs. Now we come to the stated factor for this discussion, the statewide program for industrial arts. As most of you know, state publications tend to be as general in nature as possible. Some range from fairly solid generalizations to wispy nothings. Some open so many avenues that the local teachers have a carte blanche, and in effect can do no wrong. If a cafeteria of options is opened, the role of the supervisor is severely limited. You should wonder how a supervisor can make any recommendations for the improvement of instruction under this condition. It seems that if the most that can be done is to apply a 'pat on the back', the effort is probably wasted. There is of course a practical reason for allowing room to maneuver in making recommendations, but this should be in a context of adapting local programs to a statewide purpose and a single goal for industrial arts education. That which does not relate to the goal should be recommended out.

Recommendations are actually judgments, and all judgments are in reality a mental process of comparisons. Just as you might compare two automobiles, a supervisor must make comparisons with some plan in mind. The role of the state supervisor is to compare what a local school district is doing with some general plan for quality industrial arts. Where does this general plan come from? It is well and good to say that at a neighboring school they were doing such and so, or at some distant school this practice has been observed, but this is not sufficient to convince local administrators to spend substantial sums of money unless you can relate a goal, a program and an outcome that this money will provide. I like a quote from James Pophan, who states, "the educational reformer who eloquently urges classroom teachers to change their practices may receive the accolades of the educational community, but the educational reformer who provides a set of usable curriculum materials for the teacher is more likely to modify what goes on in the classroom."

While we know that it is the function of the teacher education institutions to provide imaginative teachers who can teach creatively and efficiently, we know too that the teacher needs assistance in providing an environment that will permit creativity to be expressed. He cannot be expected to devise new curriculum materials each day and each year. He must be provided with a standard against which he can compare what he would like to do with what others have done.

The state supervisor needs a model program with which to compare the efforts of the local school district. While this may be a verbalized model, the chances for improvement will be enhanced if it is a written model that he can point to in indicating areas where superior performance has been shown and areas where improvements should be undertaken.

Providing a model for comparison is easier said than done. There are many forces outside education which help determine the direction of curricula. To note a few in our field there are pressure groups from industry, business, social protest groups, engineering, technology groups and friendly researchers analyzing social trends. Each has impact both upon the local personnel and the state supervisor.

State assistance. The state supervisor must also relate to the present standards of service within his area of jurisdiction. I will note a few statistics from New York State as an example to indicate the flexibility that is necessary in establishing a model for comparison purposes.

The last printouts from our computer data system indicate over a half-million enrollment services by 4,200 industrial arts teachers. Registration figures at various levels include K-4 elementary 8,000; grade 5, 1,600; grade 6, 4,800.

In grades 7 and 8, we have enrollments of approximately 250,000, some 80 percent of which are in one-semester (18 weeks) programs. Enrollments in secondary courses exceed 350,000.

Additionally, despite vigorous efforts at centralization of small school districts, New York State retains over 800 separate school districts, each controlled by a local Board of Education and an appointed chief school officer. This pattern is different from many other states, some of which have county school districts encompassing large areas as well as city districts with large numbers of students. Every state supervisor must examine his type of school district organization and the supervisory role he must follow in serving the best interests of the students of his state.

Of no small importance to this effort is the level of state assistance to local school districts. In New York State this varies depending upon the wealth of the local district. Currently state aid represents 49 percent of school costs for districts of average wealth. In some small rural districts this may approach 90 percent. Additionally, building construction aid from the state ranges from approximately 50 percent to above 90 percent. This means that some districts can achieve a new school building with a local input of less than 10 cents on the dollar. This aid has substantial import upon the minimum standards of school buildings.

In the Education Department there is a Division of School Facilities Planning which in general establishes minimum standards, examines building proposals, approves support levels, and cooperates in long-range planning for local districts. On this basis industrial arts has achieved shops in each new building in the state at a usual level of one 2,000-square-foot facility for each 500 students. While this is a minimum and the local district is free to build larger shops or more shops if they desire, we are able to establish facilities to provide for foundational instruction. This means that it is possible to outline an Instructional Guide for grades 7 and 8 since we know that in normal situations there will be facilities of the minimum size in which to offer instruction.

Support for the role of industrial arts in the local school additionally has come from the administrative and supervisory personnel of the State Education Department, who in the first instance approve acceptance of the school into the University of the State of New York and, secondly, periodically visit the administrative staff in the local school.

Experimental program. Now that I have given you a resumé of the environment in which state supervision in New York State exists, you may well ask, "What of the many experimental programs that are proposed?" I would venture that New York State has as many, or more, experimental programs as any other state in the nation. Many have been written up in national publications, but all attempt to provide improved instruction in the location in which they exist. In general, we applaud the efforts of a local school to devise innovative programs. One recent study compared an experimental program with the recommended statewide pattern. While the results of the one-semester study were not definitive, it did indicate that there were many methods by which imaginative and creative teachers could implement quality instruction. How do these programs then relate to the model program recommended by the state supervisor? Quite often they do not. Some may be as opposite as the two which I will now describe.

One is a pre-occupational education program that goes beyond the usual industrial arts parameters to include trade, business, commerce, government, religion and proposes in fact that the laboratory is a supplementary resource that may eventually be dispensed with. An opposite proposal indicates that industrial arts is the study of technology and that the study of industry is but one part of the whole. Commenting on some of the current national proposals, this author indicates that "it is absurd to attempt to dramatize industry and mass production techniques as the new industrial arts. While 'playacting' with industry may be appropriate to an apprentice situation, it is hardly justifiable as regular fare for industrial arts. Emulation of industry is not the goal." You may recognize these two extreme positions as coming from proposals by Dr. Ronald Stadt, titled "Enterprise", and Dr. Delmar Olson's "Industrial Arts and Technology". Programs in local districts in New York State also have this wide a variety. We range from older men doing "woodcraft" to younger men "taking industry".

From the state supervisor's standpoint, this variety emphasizes the need for a model program for comparison purposes. We know from observation that some experimental programs are very narrowly conceived. Some are entities and require facilities peculiar to their content. Some precede nothing, follow nothing. Some experimental courses require time allocations that are not applicable in other districts. Since the facility construction standards for junior high shops provide for instruction for one semester in grade 7 and one semester in grade 8, experimental programs which would call for a full year time allocation for those two grades would be almost impossible to implement. Some experimental proposals attempt to implement all of technology worth teaching within one or two years of instruction without regard to the program in other buildings in the same district.

Recommendation. I stress again that a model K-12 program, as a guide for comparison, is necessary to the role of the state supervisor.

The state supervisor must be prepared to offer recommendations, not options, if he is to be of maximum assistance to local administrators. Drawing conclusions is not enough. It takes decisions in order to make specific recommendations. The chief school officer and his staff then have an option as to the degree to which they will implement the recommendations, usually based upon the supervisor's rapport with local personnel, the sincerity and relevance of the recommendations and the clarity in relating the recommendations to an overall goal and purpose for instruction. In this manner the state supervisor functions as a leader rather than as an authoritarian, as a consultant rather than as an inspector.

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Industrial arts in relation to vocational education

Earl R. Zimmerman

The best definition I know for industrial arts and vocational education was written by Edgar Dale:

> "VOCATIONAL: To train-- is to emphasize fixed responses, to stress immediate goals.
>
> INDUSTRIAL ARTS: To educate--is to foster limitless growth and life-long learning. The world of tomorrow needs the flexible man, the intelligently mobile man, the man who can land on his feet when his job becomes technologically obsolescent."

The goals of industrial arts education should be consistent with those of the school system. Industrial arts has a special contribution to make in a total educational program. It must stand upon the demonstrated values which it is especially adapted to attain and it must be coordinated, integrated and related to other areas in the development of the total educational process which includes vocational education.

Industrial arts education is that integral part of the total program of education designed to aid students in acquiring a comprehension of technology. Through manipulative and research experiences with a variety of tools, materials, processes and products, pupils have opportunities to develop their self-concept in relationship to the changing requirements for optimum participation in an industrial technological culture.

Industrial arts is non-vocational instruction in the sense that it does not strive to develop salable job skills. It is of value to all pupils in the elementary and secondary schools, providing experiences that are progressively intensive in accordance with pupil maturity.

The scope and objectives of trade and industrial education are more specific and more advanced. It prepares senior high school boys and girls having the interest, ability and aptitude, for employment in trade and technical occupations through development of basic job skills as well as general academic education required of all citizens.

The objectives for industrial arts are:

(1) To develop literacy in a technological civilization.

(2) To develop an insight and understanding of industry and its place in our society.

(3) To discover and develop student talents.

(4) To develop problem-solving abilities related to a variety of tools, materials, processes and products.

(5) To develop an ability in the safe use of tools and machines.

Within these objectives we believe that a better understanding of the world of work, occupational orientation, consumer education are included; however, not mentioned directly.

The objectives of vocational education are:

(1) To develop basic occupational skills and technical knowledge for entrance into gainful employment in the trade, technical or service occupation of pupil's choice.

(2) To develop understanding and competence in mathematics, science, speaking, writing, drawing, blueprint reading, social studies, and health and physical education.

(3) To improve the work skills of persons already employed in trade and technical occupations through related apprentice and trade extension.

(4) To retrain unemployed workers.

(5) Success in employment is a major goal.

Industrial arts education is intended to serve a cross-section of all students found in regular grades and classes, and is an area designed to help prepare all youths for more effective living in a modern society. It is intended for both boys and girls from kindergarten through grade 12, as well as for all general adult education. Such experiences build basic and practical foundations for youth without regard to specific vocational aspects and enable adults to pursue vocational needs and avocational interests.

Industrial arts as a major course in the senior high school curriculum should be discouraged. It should be taught as an elective so that all pupils (boys and girls) will have the opportunity to gain experience in the area of their greatest interest two to five periods per week or whatever time is available.

We believe industrial arts will make its greatest contribution to education in the 70's. To do so we must work toward the following:

(1) We must eliminate the unit shop in favor of general laboratories (not more than three areas to a lab for one teacher).

(2) The three headings that all industrial arts programs will come under in Pennsylvania will be visual communications, power, industrial materials technologies.

(3) Team teaching with extensive use of teacher aids either within an industrial arts department or with other disciplines.

(4) Modular scheduling built with or without the use of a computer.

(5) Large- and small-group instruction as well as individualized instruction.

(6) Independent study for all students or for at least those that request it.

(7) Student-centered activities in place of project- and machine-centered activities.

(8) Dial-access information retrieval system used by all disciplines.

(9) Individual learning packets or materials for self-directed inquiry.

(10) Learning resource centers for all disciplines.

To be more direct about the relationship of industrial arts and vocational education in Pennsylvania, I would like to read a quotation taken from a speech written by the Pennsylvania State Supervisor of Technical and Industrial Education, Robert Jacoby. He wrote,

> "It is my firm personal conviction that there is an important place in education for both industrial arts and trade and industrial education, and if the valid objectives of each are clearly defined and conscientiously observed, they can develop side by side without material overlapping or conflict and with mutual benefit."

The second paragraph that was written was a result of an observation from Doctor

Conant in his book, The American High School Today, in which he observed that where good industrial arts programs existed there were also good vocational programs. In other words, they complemented each other. As a result of the observation by Doctor Conant, Mr. Jacoby wrote,

> "These fundamental concepts concerning the relationships of industrial arts and trade and industrial education are mentioned to show that although the programs are distinct in themselves, they must be clearly related and work cooperatively together if a school is to get the best out of each."

With these quotations I concur heartily. We want to maintain our proper proportions in the total family of education by being respectful of each other.

Dr. Zimmerman is Coordinator, Division of Industrial Arts Education, Bureau of General and Academic Education, Pennsylvania Department of Education.

Industrial arts activities across the New England Regional States

Carl W. Butler

I have accepted the responsibility of presenting a brief overview of industrial arts activities in the New England area. The information for this presentation is the result of a questionnaire sent to each Industrial Arts Consultant in the New England area.

I. WHAT ARE THE OBJECTIVES OF THE INDUSTRIAL ARTS PROGRAM AT THE JUNIOR HIGH SCHOOL LEVEL? AT THE HIGH SCHOOL LEVEL? (FROM THE STATE CONSULTANT'S POINT OF VIEW)

CONNECTICUT - (1) The study of industry and technology, (2) the development of problem-solving skills related to industry and technology, (3) the development of a degree of skill in the safe and effective use of the more common tools and machines of industry and technology, and (4) the identification and development of individual talent related to industry and technology.

MAINE - The general objectives of industrial arts in Maine are those set forth by the American Council of Industrial Arts Supervisors of the American Industrial Arts Association. They are as follows: (1) To develop in each student an insight and understanding of industry and its place in our society, (2) to discover and develop student talents in industrial-technical fields, (3) to develop problem-solving abilities related to the materials, processes and products of industry, and (4) to develop in each student skills in the safe use of tools and machines.

MASSACHUSETTS - Junior High School generally gives an orientation to occupational education and offers basic skills necessary to proceed in this area without too much difficulty.

Senior High School provides in-depth study of total industrial processes and job entry skills, and offers experiences that will help in the academic world. Also, prepares youngsters to go on to college or into the world of work.

NEW HAMPSHIRE - Junior High School is exploratory in a number of areas.

Senior High School is more in-depth, with concentration in areas of interest to the individual students.

RHODE ISLAND - Junior High School (Middle School - Grades 5-8)-(1) to discover and develop attitudes, abilities and interests valuable to the student as he continues his formal preparation for adult life, (2) to study industry and its technology, (3) to instruct in processes and materials through exploratory experiences, and (4) to incorporate safe working habits in all areas of activity.

Senior High School offers basic and advanced courses in many technological fields for students in all types of high school curricula. Many schools build a curriculum around math and associated sciences to ready youth for advanced technology studies and college. Vocational interest continues to serve a vast number of high school youngsters.

VERMONT - (1) To provide all students with the opportunity to explore industry and occupational orientation, (2) to provide opportunities for attaining knowledge of related avocational pursuits in light of the shortened work weeks, and (3) to improve the competence level of the students as consumers.

II. PLEASE WRITE A BRIEF RESUMÉ EXPLAINING THE EXPOSURE THAT YOUNGSTERS RECEIVE STARTING AT THE BEGINNING OF THEIR INDUSTRIAL ARTS SEQUENCE TO GRADE 12 OR UNTIL THEY ENTER INTO A VOCATIONAL TRAINING PROGRAM.

CONNECTICUT - The exposure that students receive in industrial arts varies with each town, depending upon organization and facilities, but generally follows the pyramid approach that will be explained later in this presentation.

MAINE - Students study the history, growth and development of industrial organizations, materials, products, processes and related problems. Through industrial arts a learner develops an awareness and appreciation of the tools, materials and processes involved in the past and present methods of production. It provides experiences in developing basic skills and knowledge common to many occupations and professions. Industrial arts also provides a means by which students can apply in practical and meaningful situations the theoretical principles of science, mathematics and other related subjects.

MASSACHUSETTS - Interpretive, exploratory, foundational (background in technology), preparatory and professional.

NEW HAMPSHIRE - In the larger school systems and particularly in newly-constructed schools, there are opportunities for students to explore several industrial areas in Grades 7 and 8. These areas usually include four or more of the following areas: woodworking, electricity-electronics, graphic arts, metalworking, plastics, drafting and power mechanics. Some schools are providing experiences in industry. Those students that elect industrial arts in Grades 9 and 10 have experiences of greater depth or in fields which have not been available earlier. In Grades 11 and 12, students may elect to enter a vocational program or continue in industrial arts with provision for specialized study.

RHODE ISLAND -K-5 - This is an intern part of the general education. There is no specific course in industrial arts as such.
5-8 - Discovery of interests, abilities and production in service industries.
9-12 - Form basis for occupational information. Not a skill preparation area.

VERMONT - Many schools in Vermont are involved in "mass" and "line" production programs as well as American Industries projects. There is also great interest in the Industrial Arts Curriculum Project of Ohio, and teachers are looking forward to the forthcoming publications and materials from McKnight and McKnight Publishers.

III. WHAT IS THE NUMBER OF SCHOOLS IN YOUR STATE THAT HAVE INDUSTRIAL ARTS PROGRAMS AS COMPARED TO THE SCHOOLS THAT DO NOT HAVE INDUSTRIAL ARTS IN YOUR STATE?

CONNECTICUT - Industrial arts is available to all secondary school students and is offered to junior high school students in the form of industrial and technical orientation, including units in production, power and graphics. K-6 receive an understanding of industrial arts technologies in all phases of elementary education through individual and group enrichment activities and experiences.

MAINE - Industrial arts is offered in 109 senior high schools and 48 junior high schools. Almost all schools in Maine offer industrial arts at the senior high school level with the exception of a few schools that are geographically isolated and have a very low enrollment. The majority of schools with an enrollment of over 500 students (including both boys and girls) offer industrial arts at the junior high school level.

MASSACHUSETTS - The trend in Massachusetts is to include industrial arts as a part of general education when construction of new school facilities is planned. All junior high schools offer industrial arts and better than 50 percent of existing senior high schools offer industrial arts.

NEW HAMPSHIRE - Industrial arts is predominantly traditional and is a part of every program in approved high schools throughout the state, and in most junior high schools. Better than 100 schools and about 250 teachers.

RHODE ISLAND - Industrial arts is offered in all junior high schools and senior high schools in Rhode Island - a total of 35 school districts.

VERMONT - 100 percent of the secondary schools in Vermont offer programs in industrial arts as is required by the State Minimum Standards Regulation.

IV. WHAT IS THE SCOPE OF YOUR INDUSTRIAL ARTS PROGRAM?

Industrial arts throughout the New England area traditionally has the following major industrial areas of activity: woodworking, metalworking, electricity-electronics, power and transportation, drafting and graphic arts. The major difference between one state and another is not the areas of activity covered, but the concept and method of implementation. For example: Connecticut emphasizes (1) world of work, (2) world of living and (3) world of play. These broad areas are implemented through (1) production and material processing, (2) power and useful energy and (3) graphics and visual communication. Some other states center activities around manufacturing, construction, communication and service industries. Each of these states has its own method of implementation.

Maine uses the unit approach, whereby the work of the semester or year is divided into series of inter-related, flexible units, each having a central theme toward which the learning experiences are directed. An example could be a unit in camping equipment covering many materials and processes.

V. WHAT IS THE SEQUENCE OF YOUR INDUSTRIAL ARTS PROGRAM?

CONNECTICUT - Grades K-6 - Individual and group enrichment activities and experiences.

Grades 6-7-8 or 7-8 - Industrial and technical orientation, production (material processing, power (useful energy), and graphics (visual communication)).

Grades 9-10 - Experience in all available categories (occupational orientation).

Grade 11 - Experiences in two major categories or areas based on interest and ability (occupational orientation and specialization).

Grade 12 - One category or area based on interest and ability (specialization).

MAINE - An occupational course in industrial arts shall be not less than three years in length and shall have a teachable content, including basic and related subjects, possessing continuity and providing pupils industrial experience of a progressive nature. Regardless of the grade in which he is enrolled, pupil placement in industrial arts classes shall be at that level which is commensurate with his previous experience. Once well-placed, his interest in and ability to perform the work required in the course shall determine his advancement.

MASSACHUSETTS - In general, the junior high school students receive one-half year of wood, one-half year of metal and related drawing (depending on the size of the school). Industrial arts is required at grades 7 and 8, elective thereafter and primarily an exploratory program.

NEW HAMPSHIRE - The general sequence is to provide exploratory experiences through grade 10 and in-depth study during grades 11 and 12. Usually industrial arts is required in grades 7 and 8 and elective in the higher grades. The sequence of course offerings is a local option.

RHODE ISLAND - Courses provide continuity from one level to the next. The completion of the courses should provide for a greater understanding of industry and technology and help the student discover and develop attitudes, abilities and interests valuable to him as he continues his formal preparation for adult life.

VERMONT - In general - Grade 7 - three basic areas of 12 weeks each area.
- Grade 8 - remaining three areas of 12 weeks each area.
- Grade 9 - elect two areas for 18 weeks.
- Grade 10 - elect two areas for 18 weeks or one for 36 weeks.
- Grade 11 and 12 - open electives or attend an area vocational center.

VI. WHAT ARE THE TIME REQUIREMENTS OF YOUR INDUSTRIAL ARTS PROGRAM?

CONNECTICUT - No time requirements, but the following recommendations:

Level One (Grades 6-7-8 or 7-8) two to three periods per week for each year - 36 weeks each year.

Level Two and Three (Grades 9-10-11) five or more periods per week - 36 weeks per year.

Level Four (Grade 12) eight to ten periods per week - 26 weeks. In addition, all offerings should be available to all students on an elective and flexible time schedule in terms of need.

MAINE - In the first year of the three or more consecutive years, the time requirement shall correspond to the time requirement for major courses (such as English, mathematics) in use in the individual school concerned, but in no case shall the time be less than 200 minutes per week.

In the two or more subsequent years of the program, the time requirement shall be not less than 280 minutes per week.

MASSACHUSETTS - Junior and senior high schools - recommended three to ten periods per week.

NEW HAMPSHIRE - Time requirements are determined locally, but generally it's one period per day in secondary schools for one credit.

RHODE ISLAND - Same as any other course in general education. No specific time allottments.

VERMONT - No firm requirements - recommend 200 minutes per week for the junior high school and many variations for senior high school.

VII. WHAT IS THE CORRELATION BETWEEN INDUSTRIAL ARTS AND VOCATIONAL EDUCATION IN YOUR STATE?

This question can be summarized by saying all states seem to agree – occupational education is a cooperative partnership with industrial arts programs offering exploratory experience to help prepare individuals to meet the requirements of an industrial-technological culture.

Most states agree that industrial arts education serves as a filter and feeder system for vocational-technical education; whereas vocational education offers each individual skill training in specialized areas.

In summarizing, most of the states are offering basically the same areas of major activity: woodworking, metalworking, electricity-electronics, power and transportation, and graphic communications. However, the method in which the program is being implemented varies in each state. Thus, the students' experiences will vary accordingly.

Mr. Butler is Consultant for Industrial Arts and Coordinator for Vocational Programs for the Disadvantaged in the State of Maine.

Overview of industrial arts in the Midwestern States

Darrell Brown

The states comprising the Midwestern region as it is divided for this report are Illinois, Indiana, Ohio, Michigan, Wisconsin, Minnesota, Iowa, Missouri and Arkansas.

I will attempt in the next few minutes to briefly describe the industrial arts activities and problems as they were reported by the industrial arts supervisors of these states.

Availability of teachers. Approximately 18,000 industrial arts teachers serve these nine states. Although the teacher shortage appears to be leveling off, there is a need for from three to four hundred additional teachers. The areas of greatest need seem to be electronics, graphic arts, plastics, technology and power. Industry continues to be the major competitor for teachers, but vocational education and school administration are beginning to challenge this domination utilizing the talents of industrial arts teachers. Teacher recruitment and retraining programs have been initiated in several states to help eliminate the teacher shortage. Ohio used EPDA Institutes to train special temporary teachers to fill industrial arts vacancies. Indiana is organizing a recruitment program through its industrial education association and the state department. Their plan is to identify and guide potential teachers in high school industrial arts classes into teacher training programs. The program has not been in operation long enough to test its effectiveness. Other states are probably organizing similar recruitment programs.

Professional associations. The importance and usefulness of professional associations is sometimes questioned by its members. There seems to be a gap between what these organizations profess to accomplish and what classroom teachers and other members believe should be accomplished. For this or some other reason the majority of Midwestern states reported a decrease in membership for local, state and national professional associations. Wisconsin was the only state that indicated an increase, but it was a very substantial 75%. Perhaps all memberships will increase before or during the national convention.

Industrial arts in grades K-6. Exposing children to the world of work at an earlier age is a movement that seems to be gaining national attention and rather strong support from local and state administrators. As a result there is an emphasis on the development of industrial arts material for grades K-6. In addition to the development of "software", some states have developed teacher training workshops to help prepare elementary teachers for the task of teaching industrial arts or occupational concepts to this age group. Industrial arts at this level is taught primarily by regular elementary teachers and is incorporated within the structure of existing subject areas. However, some of the programs use separate industrial arts classrooms and specially trained industrial arts teachers.

Middle School. The middle school movement in the Midwest is developing at a fairly rapid rate. Industrial arts programs in these schools usually fall into one of the following categories: (1) Unified arts, (2) Semi-unified arts, (3) American industry or industrial arts curriculum program, (4) Traditional (general laboratory type). Because of existing facilities and less confusion in changing to newer concepts, the traditional programs seem to be most prevalent, although perhaps not the most feasible. Like any major change the development of a feasible curriculum for the middle school industrial arts program will take more time and effort.

New approaches. As you are well aware, there has been a recent influx of new concepts and approaches to the teaching of industrial arts. The two most commonly mentioned in the Midwest are the Industrial Arts Curriculum Project developed by Ohio State University and the American Industry Project developed by Stout State University-Wisconsin. Several schools within this region are field-testing one or both of these programs. Acceptance of either by local industrial arts teachers and administrators is questionable at this time. However, several have seen enough value that they are willing to give them a fair evaluation. Schools in Illinois, Michigan, Wisconsin, Ohio and possibly others have served as field test centers. Most reports from these test centers are favorable; however, each center indicates that a certain amount of modification is needed in some aspects of the programs.

Impact of Title III, NDEA Funds. The development of industrial arts facilities in the various states during the past two years has been greatly enhanced by Title III, NDEA funds. During the 1968-69 school year it contributed more than two million dollars to Missouri, Ohio, Wisconsin and Illinois for the purchase of industrial arts equipment. (It is unfortunate that the "political bosses" have evidently found it necessary to discontinue the availability of these funds. All persons concerned with industrial arts should make every effort to assure the continuation of NDEA.)

Publications. Adequate communications are essential to any properly functioning program. Up-to-date written materials for the various aspects of industrial arts have been in short supply because of the sudden influx of new approaches, objectives and ideas of leaders in the discipline. State department and professional associations in the Midwest are in the process of developing and distributing new teaching guidelines, safety bulletins, middle school curricula, elementary curriculum, etc., to teachers and administrators.

This is a brief overview of industrial arts activities in the Midwest. I sincerely appreciate the efforts of the state supervisors who contributed to this report: Indiana-Robert Thomas, Minnesota-A. E. Pagliarini, Missouri-B. Eugene Brightwell, Ohio-Robert Gates, and Wisconsin-Leonard F. Sterry. Iowa and Arkansas had no supervisors at the time of this writing.

Mr. Brown is with the Department of Public Instruction, Springfield, Illinois.

Industrial arts activities across the Mid-Atlantic States

Allan B. Myers

Due to the extremely short period of time allotted to this presentation, a handout has been compiled from comments to a questionnaire submitted by the state supervisors in each of the eight states in this region. The handout contains facts, figures, descriptions of programs, and, more important, whom to contact for additional information. (Copies of the addendum are available from Mr. Myers' office in Baltimore.)

I asked each of the states to submit two or three programs that they consider to be "good" in the area of traditional-type programs and innovative-type programs. They were asked to interpret 'traditional' and 'innovative' in any form they desired. From this material, I then tried to allude to statewide trends. Let's take a look at these states one at a time.

Delaware

Traditional Program - One program has been identified using a general-type facility involving the areas of woods, metals, graphics and electricity using the individual project approach.

Innovative Program - One program has been identified in a middle school general facility involving a very broad cross-section of many industrial areas and teaching methodologies.

Trends - Moving away from tool-skill-oriented programs to those involving the study of industrial technology and modern manufacturing involving both sexes at all levels.

District of Columbia

Traditional Programs - Three programs have been identified. The areas of cabinetmaking and printing on the senior high school level using an individual project approach and a junior high broadly generalized program in the area of woodworking.

Innovative Programs - Three programs have been identified. Two on the junior high school level. One involved five teachers, each in unit-type facilities working with the Maryland Plan. The other involves materials, testing and metallurgy as the content core with an R & E type of program. In the senior high school, a science technology program is featured on a team teaching basis between science and industrial arts.

Trends - This school district seems to have a very good mix of traditional and innovative approaches based on the individual needs of the city.

Maryland

Traditional Programs - Two programs have been identified. One is a unit machine shop program involving the individual project approach in grades 10-12. The other program is in a rural setting involving grades 7 - 12 in a comprehensive general industrial arts facility using individual projects and group activities.

Innovative Programs - Three programs have been identified. One program involves grades K - 6 as an enriching aspect to the existing elementary school curriculum. At the junior high school level a team of three teachers, in separate general-type facilities, do extensive work with all aspects of the Maryland Plan including the seminar functions. In grades 10 - 12 this teacher is working with the senior high school aspect of the Maryland Plan. Emphasis is placed on education for the future, using major societal problems as the content core.

Trends - Quasi-vocational programs are being phased out and a comprehensive study of industry and technology at all grade levels for both sexes is being phased in. There is a very strong statewide movement toward the adoption of the Maryland Plan or ramifications of that Plan.

New Jersey

Traditional Programs - Most of the programs are classified as traditional; no particular programs were identified.

Innovative Programs - The IACP program in the areas of the world of manufacturing and the world of construction is being experimented with, using eight teachers in five junior high schools in the Trenton and New Brunswick areas of the state.

Trends - There seems to be an emphasis on traditional programs in unit general-type facilities.

New York

Traditional Program - A program was identified that takes place in the last week of

August at the New York State Fair. The program involves an active exhibit manned by students and teachers depicting examples of all types of industrial arts programs operating within the state.

Innovative Program - A mobile industrial arts elementary unit was identified, equipped as a general facility. It operates in the very impoverished areas of New York City, serving about five schools one day a week for a semester. The program features enrichment of the elementary school program.

Trends - The movement is away from the traditional quasi-vocational type of program to one that involves innovation and breadth of instruction rather than depth. Comprehensive general facilities are replacing unit shops.

Pennsylvania

Traditional Program - No schools were identified and it was stated that nearly all of the traditional programs, as they existed in the past, have been eliminated.

Innovative Programs - Six programs were identified. Two at the elementary level view industrial arts as supportive of the existing elementary curriculum. The junior high level features a broadly-based program reflecting student understanding of concepts rather than tool skill development. Another junior high program does extensive industrial testing as a part of its industrial arts program. The fifth program is operating in the Pittsburgh area with the IACP program. The last program identified concerns itself with the senior high school youngster in the area of individualized instruction with a broadly-based program.

Trends - Moving away from unit-type facilities to a more comprehensive approach to the study of industry and technology for both boys and girls. This is in part due to revision of certification standards which indirectly govern the direction industrial arts takes.

Virginia

Traditional Programs - Two programs have been identified. One is a team teaching aspect involving individual problem-solving and line production activities in a comprehensive general facility. The other program identified deals with occupational information and career guidance by use of the individual project in a general facility.

Innovative Programs - Two programs have been identified. One is a general industrial arts program perfected through the Maryland Plan with further innovations. The other program involves an interdisciplinary approach to teaching communications involving all major discipline areas of the senior high school.

Trends - This state seems to be placing an emphasis on a study involving insight and understanding of the industrial and technological nature of society for both boys and girls regardless of their educational or occupational goals or pursuits.

West Virginia

Traditional Program - No particular schools or programs were identified other than two county systems.

Innovative Program - No particular schools or programs were identified other than three county systems.

Trends - This state, like many of the rest, seems to be moving away from unit-type facilities and traditional manipulative skill-type programs to a more comprehensive approach to the study of industry and technology. More emphasis is being placed on how industry functions in a technological society.

Mid-Atlantic States

In summary it can be stated that the trend for the region is innovative-type programs with the phasing out of the old quasi-vocational types of programs that have dotted the landscape for so many years. The trend now seems to be placing more of an emphasis on the individual, giving him representative learning experiences related more realistically to industry and technology. The programs are now being designed to teach the youngsters how to rationalize and think effectively in our complex industrialized society.

Mr. Myers is Specialist in Industrial Arts for the State of Maryland.

Southeastern Regional States report

Lynn P. Barrier

Florida. There are approximately 950 industrial arts teachers in the public schools of Florida. These teachers are giving instruction mainly in grades 6 through 12. There were no major decreases in the number of teachers. However, there have been 211 teachers added since the last school year.

The major source of funding for industrial arts education comes from local and state agencies. There is some funding provided through ESEA and NDEA.

Six colleges and universities provided 50 baccalaureate graduates in 1969.

One EPDA-funded institute was conducted during the past year. The major purpose of the institute was industrial arts and space technology involving students as well as teachers.

The major programs that have been implemented were the IACP, American Industry, Junior High programs and Special Needs programs, all being implemented locally. The state's approach has been industrial technology.

The State Association is active in promoting industrial arts education. Approximately 50% of the total industrial arts professional personnel are members of the State Association.

The teachers leaving the industrial arts profession are going into industry, military, administration and vocational schools.

The major needs concerning industrial arts are: (1) curriculum development, (2) in-service education, (3) increased supervision, (4) ancillary services, (5) travel funds and (6) equipment.

Georgia. There are approximately 565 industrial arts teachers in the public schools of Georgia. These teachers are giving instruction mainly in grades 6 through 8. There were no major decreases in the number of teachers. However, there have been 17 teachers added since the last school year.

The major source of funding for industrial arts education comes from local and state agencies. There is some funding provided through ESEA and NDEA.

Four colleges and universities provided 44 baccalaureate graduates in 1969.

One EPDA-funded institute was conducted during the past year. The major purpose of the institute was the development of a career curriculum guide called "manufacturing" for junior high school. The institute included industrial arts teachers and guidance personnel from the same junior high school.

The State Association is active in promoting industrial arts education. Approximately 38% of the total industrial arts professional personnel are members of the State Association.

The teachers leaving the industrial arts profession are going into industry, administration and vocational schools.

The major need concerning industrial arts is securing a commitment at the local, state and national levels for industrial arts education and providing funding.

Kentucky. There are approximately 500 industrial arts teachers in the public schools of Kentucky. These teachers are giving instruction mainly in grades 9 through 12. There were no major decreases in the number of teachers. However, there have been 25 teachers added since the last school year.

The major source of funding for industrial arts education comes from local and state agencies. There is some funding provided through ESEA and NDEA.

Six colleges and universities provided 75 baccalaureate graduates in 1969.

Two EPDA-funded institutes were conducted during the past year. The major purposes of the institutes were wood technology at Eastern Kentucky University, Richmond, and electricity-electronics at Murray State University.

The State Association is mildly active in promoting industrial arts education. Approximately 18% of the total industrial arts professional personnel are members of the State Association.

The teachers leaving the industrial arts profession are going into industry, administration and vocational schools.

Mississippi. There are approximately 250 industrial arts teachers in the public schools of Mississippi. These teachers are giving instruction mainly in grades 7 through 9. There were no major decreases in the number of teachers. However, there have been

25 teachers added since the last school year.

The major source of funding for industrial arts education comes from local school agencies. There is some funding provided through NDEA, Title III.

Five colleges and universities provided 90 baccalaureate graduates in 1969.

One EPDA-funded institute was conducted during the past year. The major purpose of the institute was to provide industrial arts teachers with the necessary experiences to interpret modern industry effectively to their students.

The Junior High School Composite General Shop has been the major program that has been implemented throughout the state.

The State Association is not active in promoting industrial arts education. Approximately 30% of the total industrial arts professional personnel are members of the Association.

The teachers leaving the industrial arts profession are going into administration and vocational schools.

The major need concerning industrial arts is to update the curriculum so that it will be more in keeping with modern technology.

North Carolina. There are approximately 247 industrial arts teachers in the public schools of North Carolina. These teachers are giving instruction mainly in grades 6 through 9. However, there are some schools with vacancies still existing.

There were approximately ten programs in the high school converted to vocational education.

The major source of funding for industrial arts education comes from local and state agencies. There is some funding for equipment through NDEA, and one elementary industrial arts program is funded through ESEA Title III.

Six colleges and universities provided 64 baccalaureate graduates in 1969. Two of these graduates were women.

One EPDA-funded institute was conducted for elementary industrial arts teachers. This institute was primarily for the teachers in the Bertie County Elementary Industrial Arts Program.

An Occupational Exploration program, of which industrial arts is a part, was implemented in the state the second semester of 1970. This program, however, is only providing the occupational information function with manipulative exploratory activities as they relate to various occupations.

The State Association is not active in promoting industrial arts education. Approximately 35% of the total industrial arts professional personnel including teacher educators are members of the State Association.

Teachers leaving the industrial arts program are going into industry and vocational schools.

The major needs concerning industrial arts are: (1) a closer relationship between teacher education and state department personnel, (2) a variety of developed curricula to select from and (3) an effort to get industrial arts funded and the identity of industrial arts established.

South Carolina. There are approximately 238 industrial arts teachers in the public schools of South Carolina. These teachers are giving instruction mainly in grades 9 through 12. There were some major decreases in the number of teachers. However, there have been no teachers added since the last school year.

The major source of funding for industrial arts education comes from the local agencies.

Two colleges and universities provided 25 baccalaureate graduates in 1969.

The major program that has been implemented is woodworking technology.

The State Association is active in promoting industrial arts education. Approximately 50% of the total industrial arts professional personnel are members of the State Association.

The teachers leaving the industrial arts profession are going into industry.

The major need concerning industrial arts is emphasis placed upon recruiting students for college into the teaching profession for industrial arts.

Tennessee. There are approximately 508 industrial arts teachers in the public schools of Tennessee. These teachers are giving instruction mainly in grades 9 through 12. There were no major decreases in the number of teachers. However, there have been 54 teachers added since the last school year.

The major sources of funding for industrial arts education are local and state. There is some funding provided through ESEA and NDEA.

Five colleges and universities provided 51 baccalaureate graduates in 1969.

One EPDA-funded institute was conducted during the past year.

The major programs that have been implemented have been State Department of Education-sponsored conferences conducted throughout the state for the purpose of improving industrial arts education in the Tennessee schools.

The State Association is active in promoting industrial arts education. Approximately 33% of the total industrial arts professional personnel are members of the State Association.

The teachers leaving the industrial arts profession are going into industry.

The major needs concerning industrial arts are: (1) need for teachers and (2) funding for new programs from other than local resources.

Louisiana. There are approximately 525 industrial arts teachers in the public schools of Louisiana. There were 20 teachers added this year in grades 9 through 12. There was a decrease in the number of teachers, and vacancies still exist because of the shortage of teachers. The major decreases were in grades 9 through 12.

The major source of funding for industrial arts education comes from local agencies. There is some funding provided through ESEA and NDEA.

Five colleges and universities provided baccalaureate degrees.

One EPDA institute was conducted during the past year. The major purpose of the institute was elementary industrial arts.

The major programs of industrial arts that have been implemented throughout the state have been electronics, metals, drafting, graphic arts, woods, power mechanics, plastics, materials fabrication and testing, and industrial crafts.

The State Association is active in promoting industrial arts education. Approximately 20% of the total industrial arts professional personnel are members of the State Association.

The teachers leaving the industrial arts profession are going into industry.

The major need concerning industrial arts education is to amend the 1968 amendments (spell out industrial arts education in the bill), so they can get Federal money and not lose their identity.

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Industrial arts activities across the Southwestern United States

Norman L. Myers

Arizona. In Arizona, there are 669 industrial arts teachers who instruct approximately 60,000 industrial arts students. Each year, Arizona State University and Northern Arizona prepare enough industrial arts teachers so that there is no shortage.

There are three state conferences held each year. They are the National Aeronautics and Space Administration, Arizona Industrial Education Association, and Arizona Career Education. The state association has about 22% of the industrial arts teachers as members. This association meets twice annually and is involved in teacher recruitment through scholarships, in-service education and student clubs.

Expanding programs in the 7th and 8th grades offer more exposure to major areas and increasing involvement with mass production. Currently in process are 28 mass-production work sessions being held throughout the state in one-night meetings. Three regional work sessions on evaluation of industrial arts programs have been completed.

Arizona has or is preparing a number of publications. These are: Accident Prevention Guide, Drafting Guide, Facility Planning Guide, Model Curriculum for Intermediate Industrial Arts, Power Guide and Woodworking Guide.

California. In California, there are 6,000 industrial arts teachers who instruct over 600,000 industrial arts students. California needs 225-250 additional industrial arts teachers each year. The nine state colleges and two private colleges with accredited industrial arts teacher training programs prepare approximately 225-250 candidates, which is only half the number required.

California Industrial Education Association has a membership of 2,536. The state association held its annual convention in San Diego in March with over 3,000 persons in attendance.

Many school districts in California have taken advantage of NDEA Title III-B for consultant services. Industrial arts facilities have improved and expanded through the purchase of equipment and instructional materials under NDEA Title III-A funds.

Information about the 10th annual Industrial Arts Exposition and Awards Program has been sent to all junior high school and high school department chairmen. Over 800 entries will be sent to the State Fair and Exposition in Sacramento and judged in June for the outstanding, superior and honorable mention awards. These entries will be exhibited during the California State Exposition and Fair August 21 through September 9, 1970.

During November, over 8,000 copies of Planning and Equipping Industrial Arts Facilities were distributed to California industrial arts teachers, supervisors, teacher educators and administrators.

A year ago, the experimental edition of Industrial Arts Power Mechanics with a questionnaire was sent to all California high school automotive/power mechanics teachers for their review. The revised edition of Industrial Arts Power Mechanics will be distributed to California industrial arts teachers during the Spring of this year.

Colorado. In Colorado, there are 850 industrial arts teachers who instruct approximately 65,000 industrial arts students. Colorado has no shortage of industrial arts teachers, since their six state colleges prepare about 130 candidates a year, and their yearly needs are near 75.

Over half of the industrial arts teachers are actively involved in the Colorado Industrial Arts Association. Colorado has two CIAA conferences a year – Fall and Spring (October 10, 1969, and April 24-25, 1970).

Colorado holds bi-monthly articulation meetings with their industrial arts teacher educators, industrial arts supervisors, industrial arts department chairmen and CIAA president. As a result of these articulation meetings, the industrial arts programs are improving.

There has been a noticeable increase in the following industrial arts programs: aerospace, elementary industrial arts, electricity/electronics, plastics and power mechanics.

Colorado has had 27 different, outstanding in-service training programs with a total of 518 industrial arts teachers attending.

Colorado has prepared K-12 Sequence Chart and is in the process of preparing "Industrial Arts – Some Questions and Answers."

Hawaii. In Hawaii, there are 151 industrial arts teachers who instruct approximately 19,000 industrial arts students. Hawaii needs 15-20 additional industrial arts teachers each year. Its two colleges/universities prepare approximately five candidates yearly, which is not sufficient.

Because of the geographical separation of the islands, the state industrial arts association has been most active on the island of Oahu, where most of the teachers are situated. Only a limited number of industrial arts teachers on neighboring islands are members of the state association. Approximately 70% of the industrial arts teachers are members of their organization.

Hawaii has held eight conferences/work sessions the past year in the following two areas: auto body and electricity/electronics.

Hawaii's State Department of Education is presently considering a foundation program for all public schools in Hawaii. The foundation program recommends that: (1) Industrial arts be required in grades eight or nine as part of the required one-year practical arts program in all the secondary schools, (2) a minimum of four specialized electives be offered in each high school, and (3) the curriculum be designed to meet the potential needs and interests of each student.

Kansas. In Kansas, there are 932 industrial arts teachers who instruct over 32,000 industrial arts students. The four colleges/universities in Kansas prepare approximately 100 candidates yearly. Each year, 20-25 additional industrial arts teachers are hired from other sources.

Plans are being made at the present time, subject to state funding, for a series of regional work sessions which will bring some of the newer trends in industrial arts education to the classroom teacher.

A State Advisory Committee is now in the process of defining the curriculum Kansas should develop in its new industrial arts programs. It is expected that many ideas will be incorporated from the major curriculum studies and new programs in existence in Kansas.

In Hesston, Kansas, there is a new program at the junior high school level which identifies the industrial arts content in three major areas: materials and processes, power and transportation, and graphic communications. Prior to activity in these areas at the junior high school level, the students received additional study in a particular interest through an intensive, individualized instructional program which relied on the contract method of instruction.

Kansas has recently completed and distributed the publication titled Plastics for Industrial Arts.

Nevada. In Nevada, there are 115 industrial arts teachers who instruct approximately 2,300 industrial arts students. Nevada needs 15-20 additional industrial arts teachers each year, as their one university only prepares about 10 candidates yearly.

Nevada has no industrial arts association or consultant/supervisor of industrial arts education.

The Nevada State Department of Education published and distributed a fine booklet entitled Nevada Plymouth Trouble Shooting Contest.

New Mexico. In New Mexico, there are 226 industrial arts teachers who instruct approximately 23,045 industrial arts students. New Mexico has no shortage of industrial arts teachers. Their three universities prepare about 41 candidates a year, and their needs are near 30.

Their state conferences have been held in the Spring of each year. The state association is now in the process of expanding their membership.

New Mexico has been involved with work sessions in the areas of electricity/electronics and innovative metalworking the past school year.

The industrial arts programs are expanding in the areas of electricity/electronics and power mechanics. There is an increasing involvement with mass production.

New and different types of industrial arts projects are: (1) elementary career foundation project, (2) conceptual approach to drafting, (3) testing and metallurgy in general metals, (4) proposed course in engineering technology and (5) general industrial arts.

New Mexico is currently printing a new safety guide.

Oklahoma. In Oklahoma, there are 800 industrial arts teachers who instruct approximately 80,000 industrial arts students. Oklahoma needs 35-40 additional industrial arts teachers each year as their nine colleges/universities prepare about 135 candidates, which is not a sufficient number.

Over 400 industrial arts teachers are members of the Oklahoma Industrial Arts Association. They meet each year in the Fall and Spring for regional meetings.

The Oklahoma Council for Industrial Arts Teacher Educators meets each Spring to coordinate the industrial arts teacher preparation programs in the nine state colleges/universities.

The industrial arts programs in Oklahoma are using more mass production techniques in the junior and senior high schools. New trends in industrial arrs are: (1) visual communication, (2) materials and processes, (3) energy conversion and power transmission and (4) electronics and instrumentation.

Texas. In Texas, there are 1,700 industrial arts teachers who instruct approximately 170,000 industrial arts students. The 13 colleges/universities prepare close to 180 candidates yearly, which is not a sufficient number. Texas needs 70-75 additional industrial arts teachers each year.

The Texas Industrial Arts Association is extremely active with a membership of over 1,000 members. They have their annual convention the last weekend in February each year. This convention is sponsored jointly by Texas A & M University and Texas Industrial Arts Association.

In an orientation and planning meeting on December 5, 1969, the "Texas Plan" began. The "Texas Plan" is an interdisciplinary approach to curriculum development. It should last for from two to three years.

At present, there is an Industrial Arts Curriculum Project (IACP) pilot program in the Austin Public Schools.

A new state industrial arts publication which has been distributed is entitled A Guide for Planning Industrial Arts Facilities.

Utah. In Utah, there are 373 industrial arts teachers who instruct approximately 37,000 industrial arts students. Utah has no shortage of industrial arts teachers. Their three colleges/universities prepare 75-100 candidates per year, and they only need 40-50 new industrial arts teachers yearly.

The specialist in industrial arts education for Utah was assisted through the state association with two regional planning conferences and 12 in-service training work sessions in the areas of production technology and the integrated shop program.

Utah publishes the Utah Industrial Education Association Journal four times a year.

Mr. Myers is with the California State Department of Education, Sacramento.

Report from the Northwest Region

Herbert Bell

I have been asked to give you a report on the state of the industrial arts in Washington, Oregon, Alaska, Idaho, Montana, Wyoming, North and South Dakota and, for some unknown reason, other than balance, Nebraska.

Several general concepts are significant and need to be brought to your attention. The first is that the region assigned to me covers one-third of the total US land area, yet incorporates only 5% of its population. Large population areas generally do not exist. The exception, of course, is the metropolitan area in Washington State. Without large population concentrations, curriculum supervision does not exist. The number of city supervisors, or for that matter state supervisors, available to this area is at a minimum. This leaves the leadership responsibility and program improvement pretty much to the classroom teacher.

The other general concept that needs to be grasped is that remoteness is not the exception but the rule. Systems range from the large district of Seattle to schools with one student and one teacher. One must realize that in this region, generally speaking, the greatest influencing thrust on a teacher is his undergraduate experience, which normally means that his thinking reflects the college he attended. These teacher colleges tend to be remote, few, and somewhat isolated from regional curriculum projects. I am not saying that new ideas are not being utilized, but they are the exception, not the rule. These states supply most of their own teachers and in some cases even have a surplus. There are obviously exceptions to this rule: Alaska training none, recruiting 100%; Oregon, 95% and Washington, 40%.

NDEA or EPDA institutes have not greatly influenced the region. Only two institutions of higher learning in the region have been fortunate enough to influence the readers regarding the importance of conducting an institute in their state. Since the general trend selects participants from that institute, state or region, probably less than 1/2 of 1% of the teaching staffs in the Northwest have had the opportunity to attend and be influenced by a project. The state organizations have done more than a yeoman's job in this region. They have been the thread that has drawn together concerns, problems and offered leadership. Washington's organizations date back 19 years, compared to such newcomers as Idaho's association, three years old. State supervision exists in about 50% of the states. Again, Washington has the longest period of leadership - 4-1/2 years. Perhaps not altogether typical, but it does tend to spell out the problem, is this quote from Lester Batterton of Alaska: "I cannot report anything about industrial arts because we have no one specifically responsible for it. Yes, it is my responsibility but only one small part of the total load, and unfortunately it gets neglected. Last year we formed an industrial arts club in Anchorage which is still in full swing. The problem is the teachers cannot get together because of lack of roads, and expense of travel and time."

All those answering my letter reviewed their needs and are attempting to develop the material necessary to accomplish the job. Yet no one systematic approach exists.

I would like to spend my remaining time pointing out high points of programs which are in operation and which could eventually influence the region as well as the nation.

(1) High school project - Washington State University in cooperation with the Northwest Regional Laboratory (plastics, welding, electricity/electronics, drafting).

(2) Oregon's mid-high school development (two schools; 9-10 and 11-12).

(3) Bushnell's pilot project of Educational Systems for the '70's at Portland.

(4) The American Industries Project at Portland and Teacher Development Cooper-

ative program at Western Washington State College.

(5) The VICOED program at Western Washington State College.

(6) The University of North Dakota individualized instructions for small school project.

(7) Occupational versatility, a Title III at Highline.

(8) The world of work, a Title III at Salem, Oregon.

(9) South Dakota multi-occupational guidance.

Other facts of note are that production line methods are no longer unknown; open labs are being constructed. Typical are Sehome at Bellingham, Washington; Snake River High School in eastern Idaho; and Wenatchee, Washington's six-teacher lab. Elementary programs are also in operation and growing in Seattle, 16 to 36 in one year. Idaho held a summer workshop for elementary teachers last year, and a program is reported to exist at Jesup Elementary School, Cheyenne, Wyoming.

Camper and mobile units for both students and programs are being considered. Probably the biggest area problem is well-stated by Charles Burke of the Wyoming State Department, that area where industrial arts is encroaching upon present vocational agriculture programs using facilities and equipment seemingly in competition with each other, and where cooperation is in question. Can the two exist in the same lab? Who is going to give up what? Strange as it may seem, the conflict in this region is not with T/I but with Vo-Ag.

Yes, new ideas are being used. So are new areas, but wood and drawing still make up 60% of all offerings. Change at all levels is a must.

Mr. Bell is with the State Department of Public Instruction, Olympia, Washington.

aciate general session addresses

94/95

The nature of man in a social context

Alson I. Kaumeheiwa

The assumptions one might use for the analytical framework regarding the nature of man would be so vague, because of its unmanageable size, that it would make Alice's journey through Wonderland a veritable picnic. In searching the literature, one soon realizes that there are as many sides to man as one wishes to fabricate. This is quickly recognized as a hindrance. We are able to examine man objectively in terms of his physical attributes but we are unable to understand what motivates his actions. Our inability to understand the inner man causes us to draw imprecise conclusions regarding his behavior by examining his relationship with the outer world. Our inability to make valid analyses is due to the inadequate research methods and techniques we have available to us. However, since man is by nature an inquisitive creature, we keep on trying. We utilize the discreet tactics of the several sciences presently known to man. The result is that we see man in fragmentary parts and consequently can only reach fragmentary conclusions. We select, codify and quantify his behavior and infer from the data such things as human tendencies and human aspirations. If we would take a closer look at our results, we would find that our ideas of the nature of man vary according to our feelings and our beliefs.

For these reasons I feel that in grappling with the problem of identifying the nature of man, I would assume that the nature of man is inseparable from the social contexts in which it occurs. By borrowing from the many fields of the behavioral sciences, I must confess that this investigation becomes a compromise of abstract generalizations.

To begin with, our ignorance of the inner man may be attributed to a number of things. Not only are we without the proper tools and techniques for making these kinds of measures, but the mode of existence practiced by our ancestors seems to indicate that the need for survival rested outside man. For a long period, our forefathers had neither the leisure nor the inclination to study themselves. They employed their intelligence in other ways. Their time was absorbed with the task of fashioning tools, domesticating animals and cultivating crops. These tasks were dedicated to perpetuating one's self. Our ancestors found no need to examine themselves organically, since the human organism works satisfactorily without attention. Consequently, they were left with the opportunity and certainly the need to search outwardly for existence. Even as time passed and life was no longer a struggle for survival, man still neglected to attempt any understanding of his inner self because it was more lucrative to promote those products, devices or ideas that would facilitate his existence. These devices generated natural attention to the inventor, because they pleased the public by lessening the burden of human effort. Only as the attentions of man were directed toward these things did he feel content and useful, not only to himself, but to his fellow man. This desire, this focus on reducing the harshness of life, seems to embody the spirit of the nature of man. All other facets which seem to characterize the nature of man can be traced to this one focus. This focus seems to be the apparent force which weaves the structure that holds the fabric of society together. The theme, the dominant element of the society – for the focus may be one of a number of diametrically opposed views, such as religion or materialism – is always aimed at making life better for the society.

When man is distinguished in this way, we see him as one dedicated toward the maintenance of that societal aggregate he sees as the good life. With this focus as his motive, it becomes easier to understand why men behave according to specific patterns. For example, one finds that man's inventions are by and large consistent with the theme of his societal structure. The way men communicate demonstrates the relationship among invention, the theme and the structure of the society. While there appears to be no correlation between the complexity of the language spoken by any particular group of human beings and the complexity of any other aspect of their behavior, there is evidence indicating that those societies possessing complex technical knowledge have a language with an enormously large vocabulary and a very simple grammatical structure. Those societies less involved with technical growth have very elaborate language structures with a wealth of grammatical forms. The society, even within the same culture, that is intent on developing sophisticated technical systems will require a technically manageable language. Try and recall a conversation with your principal about the events of the day and later relating the same events to your wife. In a society that is concerned with a spiritual rather than a technical order of sophistication, the level of language used serves to identify a person's station in life and serves to define the limits within which the person may communicate and operate. The dialects found in many languages seem to serve this purpose. When one associates the value of language in terms of the transmission of the culture from one generation to the next, one can appreciate how this invention reduces the harshness of life. Language not only serves to maintain the culture, but it also insures its continuance.

The term maintenance seems to imply that the society rather than the individual has become the primary unit in the struggle for existence. The invention of language only seemed to point out this fact. The incorporation of the individual into the group and his training in one or another of the specialized activities necessary for the group's well-being has thus become the primary function of man's social heredity. As a result, every culture must and does include a series of techniques for group living and for the training of young individuals. The complexity of the conditions under which man must live seems to foster rather than negate the need for more activity to develop new methods to reduce the harshness of life. It is this seemingly universal human tendency which tends to amplify the culture and constantly enrich its content. Man has gone on in this way for countless generations, continually seeking to improve upon even those problems which he has solved passably well. This behavior on the part of man seems to negate the notion that necessity is the mother of invention, for there is abundant proof that the process of invention goes on even when the need is not urgently present. If culture were like the social heredity of animals, simply a means of insuring the survival of the species, this desire to improve and enrich the society might begin to slow down and ultimately cease. However, the process continues to evolve. Improvements in the society do not occur with equal intensity to all phases in the society. Instead, each society has been content to allow certain phases of its culture to remain at what we might call the necessity level, while it has developed solutions for other phases far beyond this point. No society has been content to leave the whole of its culture at the necessity level, and no society has elaborated all phases of its culture equally.

At this point we seem to have made a trip back to the beginning, for just when we were beginning to understand how the search for the good life motivates man, we are faced with the question of what motivates man to elaborate on particular phases of his culture. The question is a legitimate one, because while we may understand the desire to maintain our society efficiently, we have seen examples whereby man has elaborated on some phase of his society beyond the point where increased efficiency is commensurate with the labor involved. Anyone who has been incorrectly billed by a computer will understand this last statement. In rare cases unnecessary elaboration can be carried to a point which may prove dangerous to members of the society as well as to the society itself. For example, many Eskimo tribes placed a taboo on the hunting of seals in the summer. Although this causes no great concern under ordinary circumstances, in extraordinary summers when the land game was virtually nonexistent, whole tribes have been known to starve even when seals were in abundance.

It would appear that elaborate social systems are rarely the result of conscious planning. Societies owe their existence to a combination of physical and psychological factors, and as such represent a distinct order of phenomena which cannot be correctly understood by reasoning from either physical or psychological analogies. They depend, for their ability to function, on a long series of interaction between factors of both types. In most cases these interactions are reciprocal – the factors which influence are themselves simultaneously influenced. All life in a society is a compromise between the needs of the individual and the needs of the group. The development of social systems represents an attempt to fix and perpetuate these compromises. Eventually the compromise breaks down in the face of ever-changing external conditions which throws weight at one time with the individual and at other times with the group. Whether it be through the realization that life has somehow become less endurable or whether changing conditions (profit) rise up as the motivating force, elaborations upon the structure of the society continue. Elaborations which shift the societal emphasis have been recorded throughout history. Mumford refers to the results of shifts in cultural or societal themes as the transformations of man.

The first transformation occurred between archaic man and civilized man. Civilized man brought a unity to society based upon division and specialization of labor. This new uniformity was based upon the repression and new agreement which sprang out of the potential need to maintain the culture. While archaic culture was based on the internalized law and order, civilized man wrote the laws and structured his existence into an order. He chose to ignore the natural laws to which his physical body was subject and began to predicate his behavior on moral law. The purpose of civilized man's laws was to manage the behavior of man into a pattern consistent with the maintenance of the society. However, the development of laws seemed to make man more calculating, at the same time implying that man possessed a selfish nature.

The second transformation was destined to compensate for the selfishness of man through self-denial. In this transformation, civilized man was replaced by axial man. The term was used by Karl Jaspers to describe the religious and moral emphasis which took place around the 6th Century BC. Buddhism and Zoroastrianism were considered to be the first of the axial religions. The difference between axial religion and primitive superstitions was the belief in one god and a membership which embraced several nations. Axial man gave forth new laws that defied those of the tribe and outlined new duties that suppressed the familiar old ones. Axial man removed the superstitions of the old ways, with the cleansing of new laws and customs. This new religious consciousness takes place almost without exception in times when the familiar ways of life do not bring the accustomed rewards. These changes, however, come about with no change in material conditions. Men turned to their familiar tasks with a new sense of direction and purpose. This appears to be the shift in theme from civilized man to axial man. This shift required a change to take place which was by strenuous discipline.

The third transformation produced the chief representative of the species man. He is referred to as old world man. He accentuated his culture with variety and individuality. In fact the search for individuality seemed to be the primary concern of old world man. He elaborated on the good life through aesthetic expressions of the spirit of man and the things around him. Even the men of science displayed an aura of imagination rather than an aura of efficiency.

The final transformation takes place between old world man and new world man. The difference between them is the difference between the romantic and the mechanist. New world man traded his vitality for power, a power that was brought on by the systematic regimentation for the pursuit of material gain. He carried the material triumph of man to its present form; and at the same time he brought about the restrictive nature of man, a characteristic of his culture. Even his philosophies are examples of his mechanistic approach to life. The reactions of old world man grew out of instinctual and purposeful behavior, while new world man placed greater emphasis on causal and analytical behavior. The emphasis of elaboration in new world man's society requires that man's nature be intellectually reactive. If he does not submit, he will be subverted or expatriated. In this final transformation we see man's nature becoming as depersonalized as the procedures required by the scientific method. Cold analysis dominates every activity. To survive, man must adapt himself completely to the analytical. With intelligence uppermost, man would apply to all living organisms, including himself, the same canons he has applied to the physical world. The individual loses his identity to a larger identity. The machine in fact is precisely that part of the organism which can be projected and controlled by intelligence alone.

Whether examining elaborations of the society or cultural transformations, one soon realizes that their structures never remain completely fixed in time. This is true primarily because it appears to be the nature of man never to be completely fixed in time. The investigation seems to indicate that each transformation or elaboration takes on the qualities of a previous transformation or elaboration, except it expounds upon and intensifies those qualities. The investigation also revealed that while the transformations and elaborations might have been handled separately and distinctly, at no time did they really exist as separate entities. In fact, just as man seems destined to look to the group for survival, he remains first of all an individual, and the concept of dualism exists in even the smallest unit of the society. Social scientists have used this technique in order to distinguish and examine social systems. Parsons, for example, has developed distinguishing criteria with which to analyze social systems into five value dichotomies: 1) affectivity versus affective neutrality; 2) collectivity-orientation versus self-orientation; 3) particularism versus universalism; 4) ascription versus achievement; and 5) functional diffuseness versus functional specificity. All of the social values on the left are regarded as traditional social systems, while those on the right are considered modern social systems. I hesitate to agree with this notion since we have seen examples in politics where yesterday's liberals are considered today's conservatives. However, Parsons' model has value for us because it shows us that these values exist side-by-side simultaneously affecting each other.

What then can we say about the nature of man? Man's nature is multi-faceted; however, he is capable of operating on only a few facets at any given time. The nature of man is exhibited by the causes he accepts as promoting the good life. He will react to each situation as an individual or as a group member if the direction the group takes is consistent with his own goals. If understanding the nature of man is a necessary step toward helping man achieve his goals, we must be able to predict those motives which man will consider essential at a specific moment in history.

In conclusion, the nature of man is not a single natural desire. It only appears to be a single desire because we tend to isolate man at a single point in history. Whatever man destines to be the necessary instrument or force which can accomplish the good life, that destiny will reflect an aspect of man's nature in that aspect of time.

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Man may survive

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It is an occupational risk not adequately covered in the occupational monographs that a teacher educator must periodically reflect upon the broader problems and issues of direction which confront the profession. This is particularly hazardous when it is realized that this paper deals primarily with subjects wherein the author's role is that of a layman but whose thoughts are to be analyzed with the intent of drawing each participant into the vortex of ensuing discussions.

To speak on the nature of man, the chairman might have selected an individual from such a discipline as biology, ecology, zoology or anthropology. The reason why he did not apparently has something to do with the main title; this alludes, of course, to a supposition that this speaker will have fewer hangups on the topic than would an expert. As Margaret Mead puts it, when interdisciplinary approaches are tried, each discipline winds up defending its own viewpoint. However, this presenter may be accused of the corollary, to wit, that a new discipline may begin to form and establish its defensive buildup.

Knowledge of man is extremely fragmentary, for although more research is being done, the complexity of man results in dissecting him into "manageable" research projects. We have considerable difficulty in determining what man has been. Regarding early man, for example, the assumption of articulate speech based purely upon the fossil skull or jaw structure is now seriously in question. What man will be, assuming that he will continue to exist, is quite conjectural, and our ability to describe the nature of man appears woefully inadequate as evidenced by methods ranging from astrology and physiognomy to animism and Thomism.

The function of this session, as perceived, is to attempt a synthesis of selected concerns that appear indigenous to man and to which a college or university education should relate. The student of higher education today (notably with the exception of students in professional schools) does not see the relevance of a liberal arts education. He perceives it, from such things as the dichotomizing of man into the natural sciences and social sciences, as an incoherent conglomeration of nuts and bolts through which he may browse without any idea about what to look for but which academicians perceive as the best we have for the creation of the "cultivated man". Some limited evidence indicates that the outcome is likely to be a graduate who believes that all ideas are equally valid and completely unrelated. We have become aware that there is no correlation between the study of logic and the development of rational powers. It seems, therefore, that higher education should be founded upon the bases of a central purpose that is coherent and visible and also upon the development of ability to make a worthwhile contribution to this world.

The question of central purpose forms the substance of this paper. Perhaps it is implicit in the title, although we think not, for man is an egocentric animal. Witness the popularization of Darwin's work, which he entitled On the Origin of Species, into the misnomer The Origin of the Species. Before attacking the crux of man's dilemma, there are certain assumptions that must be made concerning his nature.

(1) He has a larger and more convoluted brain in proportion to body size than other animals and an advanced ability to learn, which permits modification of behavior according to circumstances rather than acts based primarily upon instinct.

(2) Man exhibits a high level of muscular coordination which has apparently been expedited by selective pressures to develop an easy upright posture. This has facilitated free use of the hands for making tools, using them and also for carrying possessions.

(3) Man has an advanced communicative ability, including language, which is capable of transmitting abstract ideas, as differentiated from call system capabilities of other animals.

(4) Man can be characterized as possessing group cohesiveness, which is not unique even among the primates but seems to be an inherited social aptitude presumed to be the result of evolutionary mechanisms including both the survival of members best trained to cooperate and also the factor of genetic drift.

(5) For man's survival, at least the following needs are to be satisfied: a tolerable climate; suitable kinds and quantities of food; shelter from the extremes of physical factors and dangerous organisms; and conditions suitable for reproduction.

A synthesis of the concerns facing mankind reveals four major interrelated problems: aggression, overpopulation, depletion of resources and pollution. Their order should not be supposed to imply any priority other than perhaps lending more meaning to this paper.

Aggression. Man has historically been characterized as an evil, brutal and destructive animal. Certain evidence, contemporary and historical, seems to bear this out. The fossil record of proto-hominoid primates in East Africa reveals that, although the potential life span of Proconsul was about 30 years, few of them lived that long. Certainly factors such as pestilence and predation were influential, but suspicion and fear, as of one tribe for another, seem to have precipitated not infrequent hostilities, and, if the interloper was not frightened away by vocalizations and displays, he stood a fair chance of not attaining his potential old age; instead, he might become the next meal even though Proconsul was primarily herbivorous. Probably many conflicts arose concerning territorial rights, since Proconsul was a nucleating, arboreal nest-building primate that congregated in tribes of about 25-30 individuals. However, between 25 and 15 million years ago, that is, between the Miocene and Pliocene Epochs, the climate of East Africa changed. This resulted in a modification of the flora from primarily tropical forests to savanna that was dotted with occasional clusters of trees. Consequently there was rigorous competition for survival among these tree-dewlling primates. As a sideline to this case, these conditions probably also led to the evolution of ground-walking bipeds who, being forced to live on open land, built fortress homes of stones piled into a ring. Thus these ancestors of man, to whom we attribute upright posture, were actually the losers, and they did not initially live in caves as previously thought, probably because the caves were already occupied.

Intra-tribal conflict among individual Proconsul was likely insignificant. Most of his time was spent in search of food within somewhat tribally demarcated boundaries. He used a few tools and weapons which he found as needed. Lacking foresight and also being unable to assume a comfortable upright walking posture (although Proconsul stood semi-erect to see over the grass) and also not yet having discovered clothing in which to carry things, he discarded his primitive tools after use. Since the tribe was composed of only a few males, several females and their offspring, but was without family bonds or jealousy, sexual conflict was minimal. The social order revolved primarily on age and sex, while physical ability was a secondary factor.

As pointed out before, early Proconsul, that is, of the Middle Miocene, was mostly herbivorous, but during the environmental changes that led him to become a savanna-dwelling biped in order to survive, Proconsul became a collective hunter. This was certainly not a result of conscious intent, but a development of survival demands both the need to have adequate food and to eliminate predators coupled with the discovery that they were edible. The mechanisms of such changes have recently been found to emanate from both the genetics and the lifeways of a community which has a gene pool, a distribution of phenotypes and a repository of lifeways which seek survival as a unit rather than being individually acquired characteristics as was thought previously.

Through evolution and particularly as result of great success in the reproductive aspect of survival, man's social cohesiveness has resulted in several stages of change, from the tribal pattern characterized by group self-sufficiency and the performance of diverse labors by each individual to the city-centered organization, where self-sufficiency is impossible and *specialization of labor is typical.* While this has caused greater problems and the need for realization of interdependency, it has become quite apparent that such tight clustering leads to increased anxiety and aggressive tendencies in man (and many animals) which are attributable to overcrowding and lack of space. Perhaps man will have a recurrence of the four horsemen, violence, pestilence, famine and death, in which case violence may be recognized as part of the regulatory mechanism for aggression. There are ways in which aggression acts as a regulatory mechanism, such as nuclear war or great anxiety that would serve as a brake on our next aspect of concern.

Overpopulation. Identification of this problem implies that there might be a condition below an appropriate level as well as one that would be optimum. What are the factors that would lead to this supposition?

The living world involves a continuity in time (evolution) and space (the biosphere). In the ocean, this zone extends to a depth of about 500 feet and upon land from a few feet below the surface to about the height of the tallest redwoods (assuming that they are not all extinct except as picnic tables and planter tubs). Man's indigenous range within the biosphere is even somewhat more limited.

By geographic origin, man is a tropical animal, although he is able to acclimate somewhat to seasonal and weather variations. Man, under the criteria previously set forth, now seems to date back about 2 million years in Olduvai Gorge, East Africa and in the Transvaal area of South Africa and about 4 million years at Omo in southwestern Ethiopia. Only one million years ago man's population has been estimated at about 125 thousand individuals. At that stage, he normally inhabited certain geographic areas in a pattern of population distribution that was closely related to natural plant and animal distribution and, then as now, when population reached a saturation point, man became the chief export of that area. Migration has typically been into the temperate regions of the world with but few exceptions, such as the Lapps and Eskimos of the icy wastelands, the Incas and Sherpas at high altitudes and the Mayans and Pygmies of the wet tropical lowlands.

Environment, intrahuman and intertribal competition are the dominant forces in guiding evolution and producing the diversity of human characteristics. Within the species there are numerous variations of features attributable to geographic adaptation and to developments of shelter, transportation, fire and clothing. It should be recognized, on the other hand, that many variations of human characteristics seem to be due to the accelerating survival of atypical individuals within the community who in more primitive environments would not have survived. This contributes to even greater diversity and causes one to wonder why a spotted human variety has not occurred.

A moderate projection for world population by A.D. 2000 is about 6-1/4 billion persons. Homo sapiens is doing a fine job of survival, again in part through evolution from the proto-hominoids to hominoids when some of the primates and later some of the domesticated animals underwent significant changes in sexual behavior. Apparently as a result of less rigorous survival demands, in other words less effort and time needed for food gathering, etc., reproduction became a non-seasonal possibility in contrast to specific rutting seasons for other animals. It is conjectured that this may be a basis for the detachment of sex from the basic species survival criterion of reproduction and consequently part of the reason for overpopulation. It should be noted that this modification is attributable to cultural change which effected biological change that in turn has had cultural ramifications on the family and the tribe. This reciprocity is but one example of the current practice of deemphasizing the dichotomy between the biological and cultural aspects of evolution, which is already confounded by the divergent views of environmental determinists versus cultural drift advocates. In any event, such separations belong to the antiquated duality concept of mind and body.

Considered in toto, the physical, biological and lifeways mechanisms which evolved for survival of man were based upon a life expectancy of around 14 years, whereas in the USA it is now over 70 years. Our lifeways make it good to apply science for prolonging life but not so for reducing the birth rate. To do this is bad "because frustration of conception is wrong" and, furthermore, "whoever interferes with God-established process of perpetuating human life interferes with human life itself". Should man not ask the questions how much and what kind of life will be supportable if overpopulation diminishes our resources?

Depletion of resources. According to Blackman's Law of Limiting Factors, physiological processes are limited by the least favorable factor in the system of essential conditions. Until recently there have been enough resources – trees, water, minerals, air and fuels – so that there was very little need for man to be concerned about survival. But now, for what remains of these resources, there are several diverse needs resulting in accelerating competition among the contestants. Almost invariably the non-human elements of the natural system have been on the short end. Closer scrutiny will reveal that man is also a loser.

Man is a part of natural systems but, unlike most animals, he is increasingly able to modify the environment to supply his wants in ways as rudimentary as fire, housing and food and as esoteric as a jet port and related accommodations that could have had far-reaching effects upon the Everglades. In order to achieve the cybernetic-like balance of homeostasis in nature, wide variance in kinds of species must be maintained. A loss of one kind will present a limiting factor that renders the existence of everything else a little more precarious.

Urban man of today believes that industry supports mankind and forgets what it is that supports industry. He perceives the "best" cultures as based upon the exploitation of biological and mineral resources, the accumulation of capital, invention of sophisticated technical processes, the division of labor, the domestication of animals and plants and the advancement of diverse educational, social, economic and political institutions. In numerous cases this has led to a hard-sell approach for adoption of this particularly Occidental philosophy in other nations and to the subsequent image of major countries as unthinking or else unconscious consumers of the resources in developing countries. This idea is extended, as man moves into space, by people who have no concern for depleted resources because of a mystical conviction that we can fulfill our wants from the planetary reservoir. Thus it is good if we are the first ones there.

The so-called scientific-technological revolution now in effect has one universal popular goal – the mastery of nature – which would provide further easing of man's earthly lot and greater material abundance. He has not yet developed the cost-analysis machinery that can weigh the effects upon nature, because of the complex interrelationships involved. (This is humanistically portrayed in the September, 1969, issue of Harper's magazine.)

Suppose that a 50-story skyscraper is being proposed for a city. The project looks like a good investment if 90% of the space can be rented at $12 per square foot. However, what about the other costs, such as moving 12,000 new workers into and out of the "slurbs" that will sprawl over the once-rural landscape? In order to transport them, 8 million dollars' worth of new busses will be needed, and uncountable man-hours will be lost in daily transit. Smog conditions will accelerate from the diesel fumes, and three new hospitals will be needed to care for the respiratory ailments. A new reservoir must be built to meet the increased need for water. This will dislocate the dairy farmers who will move to the city and go on welfare. The loss of milk production raises the price by 2¢ per quart. Mothers stage protests over this, which end up in riots and then the mayor wants more taxes for police.

The last one of our contemporary four horsemen to be mentioned here is the matter of -

Pollution. The quality of life is becoming a major political subject. In the recent State of the Union address, President Nixon devoted considerable attention to this concern as did the State of the State messages by both Governors Reagan and Rockefeller. Only two weeks from now, a nationwide environmental teach-in is scheduled to happen.

It is likely that the subject of environment will break down some of the existing racial barriers and generation gaps, and realignments will be formed upon conservation issues. From Time magazine, February 2, 1970, "The environment may well be the gut issue that can unify a polarized nation in the 1970's. It may also divide people who are appalled by the mess from those who have adapted to it."

Our concerns are so temporal that, without regard for the potentially accelerated destruction of one of the Finger Lakes, the New York State Electric and Gas Company proposed to build the nuclear-powered Bell generating station on Cayuga Lake with an open-circuit cooling system. Their bases for the decision were increased building and operating costs which would have meant about a 1% increase in production costs plus the unsightliness of huge forced-air radiator closed-circuit towers. Because of such lack of environmental conscience, as Aldo Leopold calls it, some kinds of industry are finding that location of sites is becoming quite difficult.

As previously mentioned, the stability of an ecological community is determined by the diversity of kinds within it. The more kinds, the greater the chance for homeostasis or natural balance over the long run, therefore, the better the chances for survival of all organisms within that community. When one factor within an ecosystem changes, the "Domino Theory" comes into play. For example, with the recent discovery of oil on the Alaskan North Slope there is the possibility that extraction may result in spills that would cover the only open sea areas. Potential extermination or forced migration would proceed, first with the plankton, then the fish and mollusks followed by seals, walrus, bears and whales and culminate with the Eskimos.

On some matters there are conflicting opinions. One case in point is air pollution. Some scientists believe that accumulating carbon dioxide may have a filtering effect sufficient to create elevated normal temperatures which could cause melting of the polar ice caps and the resulting inundation of coastal cities, while others think that fuel particles in the air will reflect sufficient heat to result in a general cooling of the earth leading to a replication of the ice ages.

Regarding changes now taking place consensus runs strong. Lake Erie is dead from acidic wastes that now permit it to support only sludge worms and mutant carp that can exist on the poisons. And Louisiana's state bird, the brown pelican, has vanished from those shores; 600 of them live on a California offshore island, but they produced only five chicks during this past breeding season because DDT deteriorated the shells of the rest. Other far-reaching effects have been found for DDT and several other pesticides. It is now recognized that these chemicals are absorbed into the ground but do not break down, instead plants absorb them, and these poisons ultimately wind up in animals (particularly omnivorous man) where they are accumulated in the liver.

Pollution and the other problems that have been mentioned are grave. Some students have confided that they are no longer concerned about how many children they want to have; they are now facing an issue of whether or not to have children.

Implications and conclusions. Man seems to have reached a dividing point but without a rational basis for decision-making. Should man be the controller of regulatory mechanisms or should he act as a natural part of the ecosystem? The effects of Christianity must be assessed in considering this dilemma. Clearly, Genesis, chapter 1, verses 26-30, has had a sustained significant impact:

"Then God said, 'Let us make man in our image, after our likeness; and let him have dominion over the fish of the sea, and over the birds of the air, and over the cattle, and over all the earth, and over every creeping thing that creeps on the earth.' So God created man in his own image, in the image of God he created him; male and female he created them. And God blessed them, and God said to them, 'Be fruitful and multiply, and fill the earth and subdue it; and have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth.' And God said, 'Behold, I have given you every plant yielding seed which is upon the face of all the earth, and every tree with seed in its fruit; you shall have them for food. And to every beast of the earth, and to every bird of the air, and to everything that creeps on the earth, everything that has the breath of life, I have given every green plant for food.'"

Thus Christianity must accept its share of the blame for the separation of man from the nature, out of which he was formed, and his desire to seek God-like mastery over it. It is admitted that Christianity is not an easy religion to understand, for these charges are confounded by Ecclesiastes, chapter 3, verses 19-21:

"For the fate of the sons of men and the fate of the beasts is the same; as one dies, so dies the other. They all have the same breath, and man has no advantage over the beasts; for all is vanity. All go to one place; all are from the dust and all turn to dust again. Who knows whether the spirit of man goes upward and the spirit of the beast goes down into the earth?"

In a sense, science and technology have been the handmaidens of Christianity in furthering man's dominion over all other facets of the environment. The rationale for this may be somewhat obtuse and an explanation in order. Science has traditionally been aristocratic, speculative and intellectual in intent; whereas, technology was lower-class, empirical and action-oriented banausic art. The merger of science and technology during the mid-18th century is partly attributable to the lowering of social barriers and contemporary democratic revolutions. Symbiotically, science and technology have afforded Christianity with the thought and action necessary to perpetrate the takeover.

Scientific principles are now readily and almost unquestionably accepted by the masses, but people do not differentiate between science and technology. Consequently, the so-called principles of technology have authenticity of exact knowledge and lead people to hope in the ability of technology to provide solutions when none are available. Perhaps the unfortuitous link between industrial arts and technology needs further consideration, for technology implies the accumulation of a systematized body of knowledge and irrefutable evidence. Should industrial arts ride on this image? Or should it emphasize a uniquely non-antiseptic, semicerebral value that adds to the stability of nature and has a vitality of method and insight offered into the nature of man?

The disregard for human factors and consequences should be accepted by science and technology, for science is the antithesis of humanism. Yet science is only the thought and technology the action. This is not to imply a need for a complete technological throwback, for, if in fact we are in a technological revolution, man cannot revert to "pre-technological" lifeways. Instead man needs to supplant unreasoned acceptance of technological toxemia with an ability to equate alternatives that will orient it toward enlightened ends. When industrial enterprise, through thoughtless commercialism, attempts to place man, and certain men in particular, over the holism of nature, what is the role of industrial arts? Will we judge or be judged?

Returning to an initial position taken in this paper, that higher education students need to perceive a viable goal, one approach that seems to fit most of the evidence is the need for a more Gestalt organization. A few colleges are trying this within the framework of ecology, which is the study of the structure and function of nature. This field is less than 100 years old but is developing a systems approach to nature. This may help man to comprehend concepts of interdependency between a community and its non-living environment. The significant effect that man has upon his environment might provide the impelling focus that students would find relevant. Such an experience might not culminate with many solutions but it is almost certain that they would be more capable of asking the right questions. There are few answers now, as the preceding has illustrated. However, through man's utilization of rational power, restoration of a view that he is a part of nature, and recognition that nature controls him as much as he controls it, man may survive. But, to quote from Pogo, "We have met the enemy and he is us".

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The nature of society

Joe E. Talkington

The topic is so all-encompassing that I perceive my role being merely to identify some of the elements of the nature of society and to raise some questions as to the implications for industrial arts teacher education.

First, I would like to identify our society as being in a state of revolution. As with any revolution, it is a time for hope and for despair. This revolution is resulting in dramatic changes, one of which is discontent among certain groups of people in our society. This discontent is manifest in all parts of the world, so with this as a basis the term society should refer to all the people of the world.

There are many reasons for this discontent, but for our purpose of discussion an assumption is made that technology is one major cause. Again, please use global technology as a frame of reference. Technology has provided us with advanced weapons for warfare, more than the necessities of life (affluence), an urban society from an agricultural society, unemployment for un- and under-skilled persons, travel to any part of the world in a matter of hours, new concepts of work with reduction in muscle power, instant communications, and a systems approach for advancing an impersonal mass society.

What can industrial education do with discontented people? Our first choice is to decide what role we will play in the revolution – participants or curious bystanders. If a decision is made to be a part of the action, we should help our youth to find satisfaction in their environment, including the technological environment. Maybe a better description would be the humanization of man. The concept is well-expressed in a quotation from Robert Hutchins:

> "What education can and should do is help people become human.... The object of education is not manpower but manhood.... The man who is truly educated, rather than narrowly trained, is ready for anything. He has developed his human powers and is able to use them and his understanding of the world to meet any new problem he has to face. He is prepared by his education to go on with his learning."

Human nature itself remains about what it has always been since our ancestors became human, but people always have to adapt their conduct, feelings and expectations to cope with the changing times. The changes are more rapid today – old religious dogmas are falling, our system of values, morals and mores is changing. We are all searching for something better, for a higher social ethic.

One of the most vital needs of man is to prove his worth. Usually this proof is by some form of action. I believe our profession can make a real contribution to this need of man if we maintain activity as an important segment of our program. Psychology tells us that man searches for new activities, fresh, stimulating and rewarding experiences. Man also wants meaningful tasks which fall within his range and ability. It is up to our profession to answer this challenge. To re-emphasize the point, I would not like to see our field of study go from doing to discussion. We cannot doubt the effect technology will have on our future and on the social forces. Somehow we must educate our future citizens to understand these social forces accompanying technological change. It should be apparent that we as teachers should know society before we help change it.

Up to this point the ideas presented dealt with a world society. I would like now to discuss our culture in the United States as being a subset of the total society. The word culture implies a system of values. These values indicate to us what is worthwhile, what is the ultimate good, or what is it we want to obtain. These questions are philosophical and deal with the affective domain, an area to which we in industrial education do not give much credence. Many of our youth are questioning our culture for "what is real in this world". A characteristic of youth is idealism and the concern for social justice. We should be thankful that so many of our youth are concerned with such a social conscience to improve our system. There are still many problems left to be solved. We in industrial education can assist our youth by helping them to see the past in perspective, understanding the present, and looking to the promise for the future. All cultures have a struggle between the new ideas and the forces of conformity. The mores of our society seek to enforce conformity. Our culture needs both conformity to keep people working together and new ideas for progress.

It appears that this condition is a description of changes that are taking place in our curriculum today. The struggle appears to mandate a new social order and we appear to be caught in this revolution. We have not been asked to partake; we just happen to be where the action is. We are not initiating the agenda of the revolution; we are merely reacting to it. Many of us question the potentially dangerous actions of groups and individuals, yet the revolution goes on. There doesn't seem to be anyone in the revolution asking about financial resources or due process; the demand is for action and change. It seems that we in the industrial education profession are caught in this revolution along with all the other segments of our society. The confusion and frustration accompany a society in revolution. We must ask ourselves, how can we communicate the "significance of life" at a time such as this? Again philosophy plays a role in assisting us to answer the question. All life rests on reconciliation of two opposite states: (1) stability and change, (2) security and adventure, (3) necessity and freedom, (4) love and hate. Life for most of us is a struggle for a "place in the sun" or peace of mind on how we can live in the environment of today. Incidentally, technology has two opposite states or faces. One face is the benefits of technology used to make the world a better place, the other the reverse or destruction of our progress. Technology, as you know, is a creation of man. If man does not have the wisdom to control the technology for the great dream of mankind, then we have the other face to consider: the nightmare of mankind.

The final element I want to mention in this nature of society is the governing of man by man. Many of us take our system of democracy for granted. Democracy is probably not the most rapidly-growing political system in the world. We may be naive if we think democracy is so good it will just have to "catch on" in the world sooner or later. Democracy is a unique, fragile state of man which should be nurtured, worshipped and protected, lest it disappear into the obscurity from which it was born. Democracy is based upon the active participation of man. Some of the student unrest today is over the gap between the ideals of American democracy and conditions of American life. If we as teachers and citizens have one shining ray of hope for the future, it must lie with our social institution of democracy.

In conclusion, it appears we in industrial education are caught up with discontented people in a revolution of change. There are many contributions we can make in meeting man's needs, one being maintenance of purposeful activity in our curriculum. Another contribution is presenting the past, present and future of a technological world. Industrial educators can include a system of values in their teaching of "what the real world is all about". One of the most important values to learn is our democratic system of government. Let us not forget why our democratic society designed and maintains the educational system: It is for the improvement of man, and that has a great deal to say about the nature of society.

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Decadence, Renaissance and industrial arts education

Howard S. Decker

The American Dilemma. A new nation was born to a continental abundance unequaled in both the richness of its mines and its forests – the fertility of its soil and the clarity of its streams. The material problems presented by virgin forests, great rivers, vast mountain ranges and pathless expanses of unsettled prairies were without parallel in history. These "problems" were conquered by stubborn, careless and materialistic men – men of action who shaped the American destiny and the American mind. In football, politics, education and in religion, we prefer them with gusto. "Being where the action is" has long been part of the American dream. The American past produced individualism and the glorification of the self-made man – a skepticism concerning the role of the expert, of the intellectual and of the social institution. For good or bad, American society has committed its destiny to the hands of the common man. At the present time, an increasing number of intellectuals have grown restless under this order. They belabor his blunders and despair at his stupidity. At best, however, the common man is more deserving of assistance than of censure. He lives in an age of uncertainty; an age crying for a *real* understanding of the *real* meaning of life. Human experience has far outrun his ability to give it rational interpretation and evaluation. He is bewildered and even appalled by life's increasing complexity. To the common man, every solution has brought to light new problems. Let me take a few moments to explore our contemporary society in terms of the common man and his problems.

In the nineteen thirties people in America decided to do something about the slums, and, of course, good old materialistic Americans saw this as slum clearance public housing. Over the thirties' period, more and more housing units were built, houses torn down and people displaced. To quote a recent issue of *Fortune*:

> "So a large, competent and militant bureaucracy was assembled on the narrow front of public housing. Over the years it went from triumph to triumph, if you measured by the size of the appropriation and the number of units built. People began to notice, however, that this program was not delivering, in human terms, what it had promised. The poor displaced by slum clearance were in many cases worse off than before. The new projects, more grim and sterile than the old slums, did not produce falling crime rates, better health and improved school performance. Typically, the housing bureaucrats and their supporters brushed off these observations as inspired by reactionary politics and, inevitably, private greed."

In the area of business, *Time* recently devoted a cover and an extended article to the increasing inefficiency in America.

Racial statistics in the United States divulge that more black children attend 100% black schools today than before the historic Supreme Court decision, and that, in terms of payoff in 1968, white males who completed grade schools earned more than blacks who completed high school, and that white high school graduates earned more than blacks with four or more years of college.

In the area of pollution, we find that the glass bottle can no longer be recycled, because of a twist top ring remaining on the bottle, an aluminum ring made in aluminum smelters which are programmed to consume 10 percent of the increased demand for electric power, which is generated by plants which pollute our air and threaten, by the year 2000, to raise by 20 degrees the temperature of our entire water supply and produce enough waste water and heat to consume all the oxygen in all 22 river basins in the United States.

In the area of the economy, in September, 1969, just six months ago, President Nixon's primary goal was to halt inflation through control of the supply of capital, and a major element of the anti-inflation fight was a freeze of 75 percent of Federal construction spending. On April 1 a Washington byline under the headline, "Nixon Aim To Stop Recession", indicates the major anti-recession step is expected to be almost complete elimination of the 75 percent restriction on Federal construction spending. Wow! (*sic.*)

I shall not dwell further on the confusion and ambivalence which face the common man and his children. Suffice it to say that American society has reached one of many critical periods in its history and that sincere attempts must be made to resolve our current dilemma.

As a society, we must provide the opportunities for man to control his reproduction, give shape to the technology which support us all, allocate the resources, distribute goods and services, design the developing future and control the process of his evolution. I believe that the working out of this process is the major societal goal of the 1970's. Several major steps are necessary to achieve this goal:

(1) The taking of accurate inventories.

(2) Reasoned evaluations from the assembled data.

(3) An evolving of limited sacrifice of the various parts of the problem areas to increase the strength of the whole system.

(4) The use of aroused and well-trained minds who can integrate the data from many fields.

Until the state of the society – the real state – is made a part of our educational curriculum, then we cannot expect realistic assessments of the role of the individual and of our social institutions.

Until accurate inventories are taken, we shall continue to blame pollution on man or beast, on technology or capitalism, on the poor or the rich.

Until we make reasoned evaluations, we shall continue to be a nation which I would describe as having efficient systems to achieve the shabbiest of goals.

Until we can coordinate our action programs, we shall continue to treat one symptom after another with no apparent progress. We can no longer permit an efficient highway and traffic control bureaucracy to turn 23 percent of the land area of a great city into highways, freeways and parking lots, at the same time the park department is tearing up parking lots to make more parks, or permit sanitation departments to dump garbage into the sea and then criticize the department in charge of beaches for inefficient disposal of the same garbage when it washes ashore.

An American Renaissance. The Renaissance of American Society can only be accomplished through the transmutation of the present dissatisfaction by all elements of that society into a creative impulse. An impulse that will infect silent and vocal majorities and minorities – blacks, whites, yellows and browns, which will bridge the two worlds of both C. P. Snow and Spiro Agnew.

Second, I call for a dramatic reimposition of what Hoffer, the longshoreman philosopher, has called "the practical sense", which he defines as "the impulse to make use of every resource and device to facilitate and expand the world's work." This calls for modification of the classical Greek preoccupation with the intellect. We must realize that the realm of the practical is one of the few in which the common man has as much chance of achieving excellence as has the educated. In the years ahead, the stability of our society will depend on how we handle the untalented. It is imperative that the American Renaissance Society provide an abundance of opportunities for purposeful action and self-enhancement for all segments of that society.

Third, our renaissance society must produce significant numbers of integrators – persons trained to handle materials from a half-dozen natural and social sciences, as well as the advanced technologies in computation, manufacturing and energy utilization.

Fourth, America must come to grips with the increasing dreariness of life and work and of the accelerating popularity of escape as relief from ennui. Technology and communication media have exposed each of us to a fantastic number of outs. Cars become "escape machines" – where we escape to the Caribbean or escape by shooting heroin. A massive effort must be made to relieve the tensions that drive people toward goals they have never chosen – toward jobs that are empty of challenge and toward escapes that destroy. Constructive escape avenues must be created, but more important, the conditions of poverty, of fertility, of low self-esteem, of prejudice, of filth and of useless education and no jobs must be quickly alleviated.

In the decade of the seventies it is imperative that America devote an important part of its energies to the pursuit of new dimensions in human existence, a renaissance of the human spirit. To do less will give credence to the new Luddites and their "let's go back to the pre-technology womb" movement and the anarchists who call ours a much-flawed sick society.

Industrial Arts and the Renaissance Society. It is essential that industrial arts play an important role in the rejuvenation of American society during the decade of the '70's. It is improbable that it will be asked to do so. The entrenched disciplines are already degrading the early attempts to establish urban planning and ecologically-oriented institutes and programs. There is little reason to believe they will be more courteous to the industrial arts. In no case, however, should our profession permit jurisdictional disputes, blockades, educational snobism or our own past idiocies to deter us from a large and important role in the renaissance of the '70's. We must do now what must be done to make industrial arts a bridge between man and his work, between art and science, and between the intellectual and the common man. There are any number of ways in which this can be accomplished. My favorites are:

(1) Industrial arts must begin a careful study of the environment and the effect of

technology on that environment. Don Maley, Lee Smalley, Delmar Olson and myself are already active in this area.

(2) Industrial arts must continue to relate to "that practical sense" that is the foundation of the American approval to the solution of problems. Research and development may well be the medium for teaching this concept.

(3) Industrial arts must continue to develop the study of the application of those materials and processes and phenomena which have relevance in today's society – fossil fuels, PVC, oxygen furnaces and hydraulics, internal combustion engine and the computer.

(4) Industrial arts must not relinquish its long-standing role as a catalytic agent in the discovery and nurturing of a creative response among even the most untalented in our society.

(5) Industrial arts must again broaden its interests and strengthen its efforts to provide those escapes which many young people and our society find rewarding, and this includes work in jewelry, leather and the other crafts.

This list can be extended, modified or completely replaced by a list of your favorites. One fact remains: industrial arts teachers in our secondary schools are interested in innovations which increase the relevance of their existing programs. As teacher educators, it is our role to provide both the direction and the spiritual renaissance to bring this about. Now, beginning in 1970.

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The illusion of technology

Rex A. Nelson

Let me begin by describing how I came to the study of technology.

A few years ago I was comfortably simmering in the frying pan of what I called industrial arts but what probably was "poor relation" of manual training. The fuel which fed my flame was the joint exercise and hacked-up footstools which were being systematically thrown in the trash can along with the irrelevant knowledge and skills I was dictating to my students. I can remember one of my biggest bursts of flame was an attempt to have a five-semester-hour course in the framing square accepted as a course for industrial arts teacher training. As I look back, this proposal was broad, since it could have been limited to only a study of the face side and tongue end of the framing square. Probably, if the word technology was being thrown around as freely as it is today, I would have entitled the course "Framing Square Technology" and had the blessings of all.

One day, as I emptied the trash barrel of my teachings, I felt a tug at my conscience and found many "name droppers" talking about something called "technology". The fact that technology was being used to give status to the endeavors of man was evidenced by the profuse use of the term.

Examples of the broad usage of the term were such titles as mental health technology, police science technology, industrial technology, mechanical technology, electronics technology, social technology, wood technology, educational technology, ad infinitum. A parallel series of occupations was identified in each of these simply by changing the term "technology" to "technologists".

Many definitions which were found related technology to the framework of industries which purported to make material things. This did not appear to give substance to the idea that technology was limited only to industries that made material things, any more than it did to the idea that technology was wholly a result of these industries.

It appeared that many people in an area termed "industrial technology" were attempting to make the effect, industry, rather than the cause, technology, the phenomenon for identification. In this instance, myopic man was attempting to make the effect, industry, the essence of technology rather than recognizing technology as a force to be discovered and applied by man.

This personal survey placed me in the larger frying pan of technology. The survey made it possible to examine technology without becoming prematurely involved in the adjectives which were being used to describe technology. This approach also made it necessary to look at other efforts of man and what he has done after the seventh day, or after he became a part of the environment.

Three areas of man's efforts appeared quite obvious: one, man is attempting to find out *what is* in the sciences; two, man attempts to determine *what should be* in the humanities; and three, man learns to *operate and to apply technically* his learning in the vocations. The missing link appeared to be that man ended each dream with, "if only it *could be*!"

Evidently, the answer to this dream of "if only it could be", is change. Obviously there is a natural change which is not satisfactory to man. Consequently man sets out purposefully to change what is into what he determines should be. The instrument he uses to accomplish this purposeful change is technology.

With the information that technology is the missing link and man's instrument for purposeful change, came the necessity of answering the question of where does man apply this instrument of purposeful change?

A search for an answer began with defining what was believed to be relevant areas of man's endeavors. The dictionary definitions divided man's endeavors into natural, "of or pertaining to the existing order of things"; physical, "relating to the material universe"; psychic, "pertaining to the mind or soul"; and social, "of or pertaining to society or its organization".

The *McGraw-Hill Encyclopedia of Science and Technology* described technology as, "systematic knowledge and action, usually of industrial processes but applicable to any recurrent activity".

These and other sources presented evidence that technology is applicable to any recurrent endeavor of man. Consequently, the combined identification of technology and these endeavors would appear as:

(1) Natural Technology
Man's purposeful pursuit of change in the character or disposition of the natural form or condition of man and animate objects.

(2) Physical Technology
Man's purposeful pursuit of change in that part of the environment which includes purely physical, including man-made factors.

(3) Psychic Technology
Man's purposeful pursuit of change in the purely psychic, mental or spiritual phenomena.

(4) Social Technology
Man's purposeful pursuit of change in the cooperative and interdependent nature of man.

The preceding four areas – natural, physical, psychic and social – are to technology as biology and chemistry are to science; arts and literature are to the humanities; and as the innumerable operational and technical skills areas are to the vocations.

Even though man identifies and utilizes the effects of technology in each of the aforementioned areas, man has neglected to identify the commonalities of technology. The fact that man is engendering himself with technology in each of his endeavors seemingly would indicate that technology is not unique to any one endeavor but something brought to the endeavor by man. Consequently, it would appear that there are certain axioms of technology which make it applicable to a multitude of usages by man and which could be studied and applied in a purposeful rather than an incidental or accidental manner. The current practice of emasculating technology by fragmenting it, rather than by dealing with its totality in each division of man's endeavors, severely restricts the identification and full application of technology.

The overpowering presence of technology in the physical, especially the "man-made" areas, has presented an optimum external appearance to everyone and made plain its influence on life. Technology as a force in the present social, psychic and natural aspects of man is not as obvious nor can it presently be subjected to a calculus of efficiency or held to an infinitesimal mathematical rigor. Essentially, technology in these areas is cloaked in innocuousness and docility, and nearly everyone remains unaware of its influence.

The recognition and purposeful application of technology in the social, psychic and natural endeavors of man also has not aroused a great deal of interest. Practical methods for establishing popular sovereignty over the natural, social and psychic terrain of man, or at least in improving conditions without civil war, or personal and political ego advancement, have seldom been a value of systems based on economic, social and political goals. Furthermore, *if* technology is not purposefully applied to bring about a change in these factors, it is doubtful whether technology or any other intercedent will be acceptable to put an end to the internecine conflicts which beleaguer mankind.

Although there is presently an unawareness of the affect of technology on the non-physical endeavors of man, the seismic results may be more deadly and damaging, or more rewarding, to man than changes in physical endeavors. Probably the real difference between the pursuit of change in the physical and non-physical endeavors of man is in the fact that the prediction and results of change in physical endeavors are within the present realm of man's use and understanding of technology.

Presently these areas, areas other than the physical or industrial endeavors of man, are coming under the scrutiny of technology. This scrutiny is not only beginning to aid in a more precise learning, but also is presenting numerous problems about the intra- and inter-actions of man. Whether or not technology is purposefully applied in the inter- and intra-actions of man, changes in these areas are being imposed on man. If left to chance, rather than purposefully applying technology, these changes will be painful and will provoke friction, jolts and resistance. If and when man augments his cerebral capacities and purposefully applies technology in the intra- and inter-actions of man, he will become the objective of his own technology. This objective may hold the promise of the preservation or fulfillment of an equilibrium between man and man, man and his environment, and within man.

Implications for industrial arts. While it appears that the vital missing link in education is technology as a discipline, it would be of great concern if the area of study professed by industrial arts was sacrificed in an attempt to pick up the whole of technology. I am convinced that industrial arts has a role to play in the physical technology area, at least in the "man-made" part of the physical technology. I am not convinced that industrial arts personnel are equipped to deal with material such as that covered in a book on Applied Genetics: The Technology of Inheritance or to carry out a program in psychiatric technology.

The efforts of industrial arts to bring to our youth learning experiences involving industry, the organization ot the "man-made" world, has been largely limited to the vocational levels of industry. In other words, industrial arts has been largely limited to only the operational and application time which industry devotes to combining or changing materials in shape and composition to make parts, subassemblies and products. The technological functions which industry utilizes to bring about purposeful change in its many and sundry endeavors have been neglected, if not deliberately shunned, in the industrial arts program.

The technological functions of industry involve real activity areas, such as: (1) Elements of managing, i.e., interrelationships of people, ideas, materials and mechanisms; (2) Industrial relations, i.e., employee-management relationships; (3) External relations, i.e., planning, executing and coordinating company relationships with the public (industrial pollution is one of the hottest issues in the United States today, not in industrial arts classrooms but in the real lives of industry and people); (4) Research and development, i.e., product engineering; (5) Marketing and advertising, i.e., evaluating attitudes and opinions of the consumer for product change; (6) Personnel, employee services – hiring, training, re-training, retaining, retiring and firing; (7) Production, plant and process planning and control, i.e., scheduling, quality control, industrial and plant engineering and purchasing; and (8) Secretarial and legal areas, i.e., advising, executing and protecting the legal entity of the organization.

Industrial arts must include the technological functions of industry, the industrial technology, if it professes to be a study of industry.

The preceding sets four unique tasks for industrial arts: (1) to present the technological functions within industry; (2) to present the technical and application functions within industry; (3) to assist the learner in understanding the man-physical technology relationships; and (4) to join the natural, psychic and social technologies in assisting the learner to understand the man and technology (purposeful change) relationship in all of man's endeavors.

Others concerned with the implications of technology for industrial arts would disagree with the preceding and would indicate that technology is and should be a study of man as a thinker, a communicator, a transporter, a maker, an organizer and a benefactor of his efforts in these areas. I am not convinced that only man thinks, communicates, transports, makes, organizes and benefits from these types of efforts.

I am convinced that man purposefully develops and organizes a complex to provide goods and services. I am convinced that within this complex he builds-in a purposeful change concept to gain dominance and to act as an intermediary between himself and his environment.

Axioms of technology. Before summarizing and attempting to set a stage of axioms for technology, it is necessary to restate certain premises which are a synthesis of this work and other writings.

The first of these premises would be that technology has no substance or meaning apart from mankind. Technology is an integral part of man and results in a constant attempt purposefully to change *what is* into *what could be* based upon *what should be*.

Technology has more influence upon the direction and development of man than either the sciences, humanities or vocations simply because its objective and result are purposeful change. The influence of technology can most easily be observed in the fact that man knows more about *what is* (science) than he can apply, change or use; he can dream about *what should be* (humanities) and ends each dream with, "*if only it could be*" (technology).

Another premise is that both historical and present-day experiences point out the presence of a force unique to man that constantly causes man to seek out and bring about purposeful change in himself and his environment. This complex motivating force is unique to man, especially to that group of men termed technologists. This force is not present in other subjects of the environment of which man is a part.

Based upon these stated premises, the following axioms are presented as characteristics of technology and subsequently as purposes and content for study and application.

Axiom I. The natural parts of the creation, including man, are subject to purposeful change.

Axiom II. The physical properties produced by man from natural elements of the environment are subject to purposeful change.

Axiom III. The ideas conceived within the mind of man are subject to purposeful change.

Axiom IV. The innate parts or characteristics of man are subject to purposeful change.

Axiom V. Man functions with technology, preceding, during and following purposeful change, and will only accept absolute efficiency as the entity of technology.

Summary. Technology, man's unique tool for purposeful change, no longer functions at only designated, precise and defined times, but is now a spontaneous movement resulting from the motive force of man with concerted effort along simple and irrefutable lines. Technology is not the solution but is the indispensable instrument for all meaningful solutions and resulting change. Technology is perfectly adapted to solutions in that it is not limited to parts, wholes or existing knowledge, but may involve any or all rationales and means needed for a desired change in a problem. Technology is perfectly efficient to all solutions in that it is consummated only when the perfect and complete solution to a problem is not only found but applied to bring about a desired change in a situation. Since purposeful change rather than simple discovery is the prerogative of organized technology, it becomes a force applicable to all solutions simply because a basic principle of any solution is a resulting change in the problem.

The profuse use of technology by man in areas which he designates and in which he specializes can be identified. It now becomes the responsibility of man in these fragmented areas to recognize, learn, teach and apply the axioms of technology in order that this unique motive force of man can be fully applied in proceeding toward absolute efficiency in his existence.

The provincialism of the present simple liberal arts and science education system, along with the human operative training system, must be subjugated to the totality of developing man. An educational system which only develops man as a theorist, discoverer, operator or technician leaves change to chance rather than to purposeful pursuit. In order to be complete, the system needs to be extended to include the development of man as both the recipient and producer of purposeful change. The neglect of industrial arts to include purposeful change areas of industry, or the industrial technology, seems to be a mockery when we look at our objectives. This mockery will only be eliminated when physical technology becomes an integral part of our content and a study of man's purposeful change in the physical and man-made environment is purposefully rather than accidentally or incidentally pursued.

Of the areas previously described – science, technology and the humanities – only technology appears as not being purposefully identified and presented as a body of knowledge for study and use by man. This negligence seems a mockery when only technology appears to have the components necessary to bring about purposeful change.

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The nature of technology

Paul W. DeVore

The term technology has taken on new meaning for man, particularly in recent years. Technology has been and is a rather vague, complex phenomenon which has elicited great hopes and many fears. The more man has become aware of technology, the less he seems to know about it.

But those who have become aware of the phenomenon are becoming more and more concerned with the many implications.

> Aware that we are living in the midst of a technological revolution, we are becoming increasingly concerned with its meaning for the individual and its impact on freedom, on society and on our political institutions. Side by side with messianic promises of utopia to be ushered in by technology, there are the most dire warnings of man's enslavement by technology, his alienation from himself and from society and the destruction of all human and political values. (7, p. 143)

The nature and characteristics of technology seem perplexing and ambiguous. And rightly so. Technology is not a natural phenomenon. It is a created phenomenon. It exists only where man exists. Without man there would be no technology. However, technology was not created by all men. And herein lies the problem, particularly for those attempting to prepare for the future, as are those in the field of education.

The field of education has been charged with the responsibility of preparing youth for a future, a future determined largely by technology. How does one find out about technology? How do we obtain information to aid in planning for the future?

First, it is necessary to recognize that the pursuit to determine the nature of technology is really an effort in pattern discernment or recognition within given contexts. It is a matter of critical distance obtained by a knowledge and understanding of the past in relation to the present and projected future. It is a perspective from several vantage points. It is an attempt to see the total rather than isolated elements.

The true comprehension and understanding of technology is a venture of relatively recent times and for several reasons.

(1) Only in recent years has the study of technology been considered a worthy endeavor.

(2) Time has been required to collect, analyze and synthesize sufficient data to focus attention on the nature and structure of technology.

(3) There has been a failure to recognize the quantitative difference between primitive technology, craft technology, mechanical technology and modern technology.

Confusion has resulted when men fail to realize that the technology of today is in no way identical to the primitive or craft technology of yesterday. It is also the failure to realize that the social and cultural climate of the society in which technology exists determines to a large extent its nature or characteristics. The technology of today is an entirely new phenomenon. Whereas primitive technology had no reality in itself but served merely as an intermediary between man and his environment, modern technology has taken on substance – become a reality in itself. (11, p. 63) Man's concept of himself and his technology is different today. He views himself and his world from a different perspective, a perspective aided by the new technology. As he does so, he discovers that technology is more than hardware. Most students of the phenomenon have concluded that the influence of technology on culture would be unintelligible if technology were understood as no more than hardware. (23, p. 492) It is many things. One can attempt to define it, but definitions are sterile and produce little fruit. The complex human and cultural relationships must be described if one is to obtain a true understanding of the nature of technology.

Therefore, any discussion of the nature of technology must include man. It must include consideration of man's society and his culture because technology is more than things. It is how man works, puts tools to work or goes about tasks. Perhaps more appropriately, it is the organization of knowledge for practical purposes, including both the theory and practice of doing.

Buchanan notes that technology is a Greek word and was, in Greek times, a discussion of the human arts. It was concerned with man doing. The Greek word for art, interestingly, was techne. It signified the power or capacity, habit or skill, and the intellectual virtue of a man to make a product or an artifact. (2, pp. 151-152) But these are only definitions and do not enable us to understand the true nature of technology.

In the beginning. The beginning of understanding the technology of today is the eighteenth century. This is the beginning of the technology which characterizes our civilization. It is by analyzing technology prior to this period and comparing it with the technology that followed that one can obtain an understanding of technological progress so necessary to comprehending the nature of technology.

A study of the technology of societies which preceded ours identifies characteristics specific to those societies and their technology.

(1) Technology was applied only in certain narrow, limited areas--the life of the group was best described as non-technical. (11, p. 64)

(2) Technology in primitive societies occupied a very small portion of the day compared to the leisure time devoted to sleep, conversation, games or, best of all, meditation. (11, p. 65)

(3) Technology was local. Social groups were very strong and closed to outsiders. There was little communication. Technique spread slowly, mainly because it bore the stamp of a whole culture. (11, p. 68)

(4) Technology evolved slowly. Until the eighteenth century, technical work was purely pragmatic, inquiry was empirical and diffusion slow. Almost unconsciously men kept abreast of technology and controlled its use and influence. (11, p. 69)

(5) Primitive technology reserved a choice for the human being. Some societies were oriented toward the exploitation of the earth, toward war, conquest and expansion in all forms. Other societies were inwardly oriented; they labored just enough to support themselves, concentrated on themselves. They were not concerned with material expansion. They erected solid barriers against anything from without. (11, p. 76)

Early man did have tools and ways of using tools. But his tools and techniques were intrinsic to his way of life, and his way of life determined, to a considerable degree, the technology developed or adopted. It is important to note also that the tools of the primitive and craft eras involved tools and techniques which could be invented over and over again by an individual man with limited experience and limited physical resources. No written record or blueprint was required. The tools and techniques were not that complex. Not so the technology of today! The technology of today is knowledge-based. There are written rules and formulas. Man is dependent on other men for information, knowledge and resources.

The technology of today crossed an important threshold in the eighteenth century and became self-sustaining. This resulted from the establishment of rules for technology. Prior to this time technology had what was known as conventional rules which were adopted with no particular reason. Conventional rules were culture-centered rather than technology-centered and consisted of rules such as tipping one's hat or striking the anvil twice before striking the metal. (3, p. 339)

The establishment of grounded rules, rules based on a set of formulas capable of accounting for effectiveness, changed the nature of technology. Effectiveness could no longer be accepted on empirical evidence. It was now necessary to know why. (3, p. 339) Some believe this was the beginning of the rationalization of technology, the formulation of the rules that control the productive process. Perhaps it was also a return to the original ancient meaning of technologia, the giving of rules to the arts. (2, p. 157).

Modern technology. The technology of today represents a complete change from past technologies, not only in degree but in kind. The technology we have today was born during the period of the so-called industrial revolution. It was then that the foundation for this form of knowledge was established. The foundation rests on three critical elements. (6, p. 345-6)

(1) The collection and organization of existing knowledge.
(2) Systematic analysis of the knowledge.
(3) Publication of the knowledge.

It was this base which established the beginning of modern technology – a technology with certain well-defined characteristics totally different from man's primitive technology.

One of the characteristics of modern technology results from earlier beginnings. It is called self direction or automatism. (11, p. 79) Essentially this means that the choice between two methods or techniques or ways of doing a task is determined no longer by human desires but in terms of technical efficiency. This came about from the recognition that knowledge, systematically acquired, could be applied systematically to work.

A second significant characteristic of modern technology is, in some measure, based on self-direction. It is called self-augmentation. This means that technology is cumulative but in a geometric rather than linear ratio. It means that technology is incremental and that each individual contributes improvements until such time that a critical mass is reached and technical progress moves forward another significant step. (11, p. 85)

There is a debate as to whether technology is truly a rational process. There is no debate, however, that technology has the characteristic of artificiality. Technology is a created phenomenon and not a natural one. According to Ellul, technique as art is the creation of an artificial system.

Daniel Bell believes that the artificial system man has created is not rational. He believes it undermines and dissolves the whole structure of rational cosmology on which Western culture is based. (25, p. 428) He claims that rational cosmology is based on the linearity and singularity of our experience, whereas technology is not. He believes technology thrusts upon man a multiplicity and interaction of experiences which will ultimately create serious problems for society as a whole because it will lead to a clash with the existing modes of perceiving and comprehending the world. And he is right. The structure of thinking and ways of perceiving have changed.

McLuhan points this out very clearly. He notes that technology has moved beyond fragmented mechanization into the world of growth and organic interrelations. There is a multiplicity and interaction of experiences. McLuhan uses the movie to explain his point.

> The movie, by sheer speeding up of the mechanical, carried us from the world of sequence and connections into the world of creative configuration and structure--a transition from linear connections to configuration. (22, p. 24)

These are fundamental changes in the concept of technology. New patterns and new configurations have begun to appear when men have met to consider the new technology. During discussions at the Harvard Program on Technology and Society, one of the members came up with a grid for classifying all technologies. It was an attempt to show new connections, new configurations. It was suggested that:

> all technologies might be classified as ways of transforming, transporting or preserving energy, matter, information, people or the environment, so that, for

example, a shift from hydro-electric to nuclear power is seen as a change in a way of transforming energy. (23, p. 480)

A third major characteristic which describes today's technology is monism. This means there are no independent parts. Technology is an organic whole. Regardless of where a given technique is used, it presents, everywhere and essentially, the same characteristics. (11, p. 94) For instance, technology transcends political and ideological differences in such areas as the precipitation of regulations for the efficient operation of international postal, air and surface transport, telecommunication services or world health policies.

The nature of technology is different today, as are the problems. And the character of thinking involved in today's technology is determined by the problem. Technology is problem-oriented, and it is the nature of the problems that determines the thought processes required. For instance, McLuhan cites the fact that the "content" of any medium blinds us to the character of the medium. The way one views the world determines his problem awareness and the way he states a problem. IBM is an example.

> When IBM discovered it was not in the business of making office equipment or business machines, but that it was in the business of processing information, then it began to navigate with clear vision. (22, p. 24)

We thus discover that technology is much more cognitive than previously believed. In fact, it enjoys considerable cognitive autonomy.

We also discover, as the question of the nature of technology is pursued, that there is a quantitative difference between the mechanical systems of the past and the cybernetic systems of today. Among the several quantitative changes in the development of civilization, including the discovery of a tool, the discovery and deliberate practice of agriculture and the industrial revolution, was the discovery that one tool could be used to make another tool. This idea or concept was the beginning of machine tools (tools used to make tools) and the early industrialization of mass production. The development of machine tools provided the base for industrialization to accomplish its accelerated growth.

These tools were different from the tools of the primitive and craft eras of technology. The production of the machine tools and other specialized tools of the mechanical era separated and specialized as mechanization increased. What was once done by one man was sub-divided and fragmented into many operations, often accomplished in widely separated geographical locations. Man became dependent upon others and established, within the limits of the transportation and communication networks of the age, national entities.

The technology of today is different from the mechanical era of the recent past. It contains the element of technical universalism. There is the development of an organic whole and a uniting of functions rather than fragmentation. This has come about largely because of new information and control techniques. Man discovered, when he began to automate his mechanical machines, that automation involved a process called "feedback" and that feedback was information.

> That means introducing an information loop or circuit where before there had been merely a one-way flow or mechanical sequence. (21, p. 307)

The new technology gives primacy to unity, process, information, learning and interrelationships. There is a universalism to it wherever it exists and, as Ellul reminds us, "In all countries, whatever their degree of civilization, there is a tendency to apply the same technical procedure." (11, p. 116)

A global network has been established and national technological economics now require access to the material resources of the whole earth. Everyone is related. No one is entirely self-sufficient. The mass has become critical. It now depends on an increasingly shared pool of freely available, quickly transferred information and knowledge to sustain the process. (20, p. 268) There is a unity mandated by technology.

This new reality and the new possibilities, created by man-singular which affect man-plural, have come about largely because knowledge has become a prime industry. (8, p. 264) The new technology is knowledge-based, and energy and production tend to fuse with information and learning. (21, p. 304)

Once again, however, when the critical mass has been reached, when the system reached proportions of the size, scale and complexity which challenged man's ability to comprehend and control, man-singular developed a system capable of control and decision-making for the large, complex, global networks of technology. We know this development as cybernetics.

Thus, we discover another characteristic of technology. Man, through technology, creates new realities. We also find that mechanical technology was limited. It could progress only to a certain level. This is a clue to another characteristic of technology.

We find there are definite patterns in technological development. A knowledge of these patterns would perhaps enable us to predict future direction. For instance:

> When a new technology emerges, the steam turbine (or computer) for example, the process of improving and perfecting this technology is at first very rapid; then there is a decline in the curve of efficiency, and then progress is very minute. And then a switch to a new technology often occurs. (26, p. 435)

We now have a graphic portrayal of technology. We have a tool which aids our understanding.

This is a penetrating characterization of the nature of technology and provides man with a new concept with which to utilize technology for his benefit.

As the reservoir of technology has increased, new patterns and configurations have appeared so that man today knows more about the nature of technology than previously. We know today that technology must be considered from a global and systems point of view, an organic whole. We know that technology is a collection of interrelated and intercommunicating units and activities. (5, p.36) We know that technology requires confirmation. It is tested by a very efficient formula--"Does it work?"

We also know that technology creates new opportunities and new problems for man and society. We know that the true nature of technology can be understood only in certain contexts; the social and the human.

Social elements: There are definite disagreements as to the relation between technology and society. There is agreement that the nature of technology cannot be determined apart from how it is situated in society. Some students of technology assign considerable importance to the social context.

> The social context, the economic structure of society, the existing social mores and aesthetic predilection--all have their imprint on the technological phenomenon and, to a certain extent, determine its character. (25, p. 382)

However, this point of view is probably not totally true today. Technology is a global system. Materials production, distribution, transportation and communication are operated in global networks by organizations extra-national and beyond the human and technological resources of any one nation or region. Each system is interlocked and interrelated with others. Local societies, cultures and even nations have little effect on the direction of technology.

Whereas mechanical technology fragmented the world and produced competing nation-states, the technology of today is apparently unifying the world, at least in the realm of technique. Man's technological decisions are determining the future for man.

Ellul believes that technique has taken over the whole of civilization:

> Without exception in the course of history, technique belonged to a civilization and was merely a single element among a host of nontechnical activities. Today technique has taken over the whole of civilization.... It has come to be the "intervention" into the very substance not only of the inorganic but also of the organic. (11, p. 128)

As technology becomes available to more and more people, as more nations embrace technology and industrialization, the more global it becomes and the greater the alteration of existing societies. Societies may not adopt certain technologies. There are many examples of societies that have not embraced technology. But for every technique adopted, there exists a new choice, a new mix, within that society which portends changes in the social and cultural structure of the society. For example, the introduction of the automobile into American society altered the courtship pattern of the young. The airplane, television and the birth control pill all altered the options available to man. And the more advanced the technology, the greater the interdependence of man upon man, whether he is aware of the dependency or not.

Modern technology is different from primitive technology. Primitive techniques were accepted into the society without alterations to the social and cultural structure. Today it is different. Each major new technology requires a whole network of supporting services which mandate new institutions, new skills, new occupations and new social patterns. One need review only a few recent technologies to accumulate a list of social changes. The diesel engine, television or the computer provides numerous examples. Each of these respective developments has increased tremendously the power of the new technology in terms of transportation, communication and control. Developments such as these point up one other characteristic of technology.

Today the nature of technology forces us to involve the public in decision-making, both nationally and internationally. The greater power and potential of technology require man to seek new forms of governmental organization as a means of providing for systemwide planning and control of technology. Man has thus created a new reality for himself.

Human elements. The question is: "Can man-plural understand and control what man-singular has created?" Not all men are aware of technology in their environment. Most are controlled by it. They are manipulated by it. Many are as oblivious of it as they are of the air they breathe. Many resist its reality and refuse to study it. They want to return to an age long since past while enjoying the fruits of the new technology.

The technology man has created is, in reality, an extension of man physically and mentally. It alters his biological capacity and enables a land-bound biped, without gills, fins, or wings to be at home in the water or in the air. (5, p. 29) It also creates new relationships and bonds between men. Technology shapes man's view of himself and others.

> All of those who follow the same technique are bound together in a tacit fraternity and all of them take the same attitude toward reality. (11, p. 131)

Yet many equate technology with things, tools, processes or products. But technology is a very human enterprise. It is, according to Drucker, about work. (5, p. 30) Man's work is more and more based on knowledge and the application of knowledge to work. Not only has work changed but so has the concept of skill. We discover, as we examine the role of work and of man as a thinker, as a doer and as a performer, that skill is different today than it was yesterday. In fact, skill may be the last thing required by the worker when a major technological advance is made.

Feibleman illustrates that knowledge precedes the practice of skill by noting that the skill of the aviator or the skill of the typist could not have existed before the development of the airplane or typewriter. (12, p. 320)

Technology is a very human endeavor. Today it unites for man both the universe of doing and that of knowing.

The new technology unites and brings together, under unifying concepts, those elements that were fragmented during the era of machine technology. Man's work has been and is being changed. What was once fragmented and centralized is being integrated and decentralized. (22, p. 24) As work becomes knowledge-based, individual skills, also knowledge-based, adapt. The individual thus assumes a new role in relation to technology and extends the range of possibilities of what man can do in concert with his physical universe.

Conclusion: Technology is the story of change. It is the story of man's creative endeavors in determining new ways of knowing and doing. It is the creation of new possibilities. It is man's attempt to make his world more livable and more predictable.

Not all men have engaged in the creation of technology, but all men have, to varying degrees, used technology and have been and will be affected by it. The technology man-singular has created is a tremendous force which requires direction and control. We realize now that a precarious balance exists between man, technology and the physical universe. The challenge of today and tomorrow is to enhance our ability to measure and to predict future technological developments and their probable results or consequences.

The questions must be future-oriented, as technology has always been.

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Impressions of doctoral study at an institution proposing a doctoral program

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As one develops a formal proposal for doctoral study, he may view present doctoral programs somewhat critically. In programs already implemented, reasons for doing what is being done may be rather apparent. Yet, it is believed that the view from an institution aspiring to offer doctoral study could be refreshing.

A committee has been established at Stout State University to prepare a formal proposal for a doctoral degree in industrial education. A description of the committee by title will show the breadth of representation on this six-man committee.

(1) The University Curriculum Coordinator, representing the School of Education.

(2) The chairman of our Physics Department, representing the School of Liberal Studies.

(3) A member of the Graphic Arts Department, representing the School of Applied Science and Technology.

(4) The director of the MS degree program in vocational education, who is also the director of our Ed.S. (sixth-year) program in industrial education.

(5) A member of the industrial teacher education staff who is also director of the undergraduate major in industrial arts education.

(6) The director of the MS degree program in industrial education, the provisional director of the doctoral degree program, and chairman of this committee, who is also your speaker.

It might be added that the doctoral preparation of each of these persons was taken at a different doctoral institution.

Our immediate task is to prepare a proposal for on-campus consideration which we anticipate would be submitted to our Board of Regents for approval and finally to our Coordinating Council on Higher Education. At that point we will call on a preliminary accreditation team and hopefully in the summer or fall of 1972 implement an approved and accredited doctoral program.

At the moment we have several more questions than answers, but let me suggest a few of our impressions.

Teaching doctorates are needed. Every so often we read in the popular press that there are now more Ph.D.'s than we need, and that the situation may get worse. The statement may quite possibly be a true one, but may I point out that one of the criticisms of higher education has been that we have too many research-oriented doctorates and not enough teaching doctorates. In fact, we tend to train people out of their teaching positions into administrative and research positions.

E. Alden Dunham in Colleges of the Forgotten Americans has written:

> More of these academic types, with or without Ph.D.'s, are desired by the departments to provide the upper-division majors and graduate work at the master's level. Yet it is the need for teachers in the lower-division, general education courses that brings forth professors of English, for example, to take care of freshmen and sophomores, whose numbers are increasing. The professors of English being hired can't wait to gain position and rank so they may concentrate on what they have been trained for--research at the graduate level. Many of these people, hired to teach undergraduates, immediately want to turn this essentially teaching institution into a carbon copy of the research institution which they just left as graduate students. The situation is ironic, to say the least.(1)

He further states with regard to the statement that there will be an abundance of Ph.D.'s:

> All the state college people with whom I spoke reject the thesis that soon there will be an abundance of Ph.D.'s, ... Actually, they say, recruiting Ph.D.'s seems to get harder every year. (2)

This, coupled with the increasing numbers of high school students going on to college, augers for the need for doctoral preparation for excellent teachers for these students.

> By 1980, 70% of all high school grads will go to college. The availability of free and unlimited education through college will augment this trend.(3)

One impression we have, then, is that there is a need for doctoral preparation and that we can contribute to such preparation by preparing doctoral candidates for a lifetime of professional activity in teaching industrial education in secondary schools, post-high schools, in junior and community colleges, and in four-year and graduate colleges and universities.

Questions of program content. Some interesting discussions arise when we ask the question: "Of what should the program consist?" There seems to be agreement that competencies in professional education and research must be included, but which competencies and to what level of sophistication? These questions will have to be resolved.

A more interesting and possibly more elusive question is: Should doctoral candidates be given opportunity to develop further in technical areas? We believe they should and that a minimum of 50% of their work should be in what we call the Component of Industry and Technology. Having made that statement, we next must come to grips with what are these competencies which should form the base for such advanced study? Should they simply be more concentration in woods, metals, drafting and the like? Should the candidates study the new directions in industrial arts as advanced content? Should they study the impacts of industry on man and society, should they gain further support in mathematics, physics, chemistry, and, if so, how can graduate credit be given for work which may not, in the eyes of these teachers, be graduate instruction in their discipline?

What should the culminating experience be? If we are not preparing researchers, then what should the culminating experiences be? An internship in college or university teaching? What colleges and universities might like to cooperate with us in providing internship experiences? Should practicums be provided? and what should their nature be? What kind of a final written report for internship or practicum should be expected?

Role of the Ed.S. degree in a doctoral program. The Education Specialist (6th-year degree) is relatively new. With the 1966 comments of the Harvard Committee on "The Graduate Study of Education", we might assume that it could be of little significance, for they say:

> We propose that the Ed.M. in scholarly or disciplinary fields and the general Ed.M. be given up, or else radically restricted, since they are at best stepping stones to doctoral study and do not in themselves represent a clear and "terminal" level of professional competence. The presumption should then be, as it is generally understood to be in the arts and sciences, that in the academic or scholarly fields the master's degree is insignificant, and that it is instead the doctor's degree that sets operative goals and standards.(4)

If their rationale suggests little value for the master's degree, presumably only the doctorate is of any lasting value. In fact, they go on to say:

> It is doctoral training that appears to us to have the greatest potential for fundamental and long-term influence upon the field of education.(5)

Perhaps this is so, but I submit that not every one who is able can continue or wants to continue to the doctorate. Master's degrees and specialist degrees should not be viewed as stepping stones for everyone. They should be looked upon as plateaus of formal preparation for a particular purpose as well as stepping stones for those who find it within their means and interests to take the additional steps or larger steps.

This raises the questions: Should any of the work of the education specialist be accepted towards the doctorate? Trends across the country seem to be that the Ed.S. degree is terminal. Perhaps with the research Ph.D. as the next step, this is quite appropriate. However, we are beginning to view our Ed.S. degree in its entirety as the first year of work toward the doctorate. The immediate question this poses is: Will we honor the 6th-year work of other institutions where such study is considered terminal? We may have to evaluate the transcripts of each case carefully, but we hope means can be found to use much of the work if not all of the work of accredited 6th-year programs.

No doubt the key point in such evaluation will be: Does the work taken really lead toward the kind of doctoral program which we propose? Our impression is that in most cases much of the sixth-year work will be likely to lead toward such ends.

Cost accountability. One does not long consider proposed doctoral programs before cost becomes a consideration. Allan Cartter writes:

> By its nature, graduate education at the master's and doctor's level is several times as costly as undergraduate education. This is true because of the necessarily closer working relationship between master and apprentice scholar, the high cost of library and laboratory facilities, and the relatively limited contribution which advanced students can be expected to make to their training. In the major state universities in 1967, the average educational cost per student was in the neighborhood of 3,000 dollars per year, and if one uses a fairly typical budget formula rule of thumb (such as that of the University of California), that the ratio of costs for lower-division, upper-division, master's and doctoral education is 1 : 1-1/2 : 2-1/2 : 3-1/2, the cost to the institution of one full-time student in a typical doctoral program is estimated to be in the neighborhood of 7,500 dollars per year.(6)

Means must be found to reduce these costs. The taxpayer is not willing to shoulder higher costs, and the mature graduate student cannot. Quoting Dunham again:

> First-class graduate work is done on an apprentice basis, almost a one-to-one relationship between student and professor. The assumption among academicians is that this costly tradition cannot be changed without sacrificing quality. This may be true, yet I wonder if the assumption has been seriously examined. From a social-benefit viewpoint, a case could be made that a slum child in a first-grade class with 30 or 40 others needs more individual attention than a 23-year-old graduate student. It seems somehow strange that we spend the least money on young children who don't know anything and the most money on young adults who think they know everything! What is especially bothersome, almost fraudulent, is the way in which the enormous per-pupil costs of graduate instruction are passed along to taxpayers and parents in the form of higher tuition for undergraduates. What is fraudulent is the fact that the unsuspecting taxpayer and parent willingly support higher education in the belief that the soaring costs will be reflected in better-quality instruction for his freshman son. In prestigious universities, faculty salaries are constantly bid up either to recruit or to protect faculty members who spend little time with undergraduates.(7)

We are more than likely to be held to a type of cost accountability in our programs which has not been the case in the past. We must either be able to defend this higher cost ratio on an economic basis or change the ratio.

Will professionals have shorter work weeks? As a final impression, let me turn to a more general observation. We have all heard projections about shorter work weeks. If my recollection serves me accurately, I heard Dr. Delmar Olson say in an address in Wisconsin about two years ago: "If the present trend continues at the same rate, by the year 2000 no one will be working." He went on, of course, to point out that it was unlikely that this trend would continue at this rate. In fact,

> For as far into the future as we can see, we are going to be terribly short of the really top-flight professionals--executives, historians, ministers, poets, educators, engineers and so on. We are going to need more of them to deal with the increasingly complex society and the growing population living in it. The top professionals are going to need more knowledge to do their jobs well. They are going to need much more wisdom than most of them have now, because the moral and ethical consequences of their acts are likely to be much greater than they have been in the past. They will have more powerful tools with which to manipulate society and they will have to think more in terms of long-range planning than ever before. They will have to keep in touch with the latest thought in their areas: their formal education will be unending.(8)
>
> People who would have no trouble at all making use of as much leisure as is available don't have leisure, while the ones with routine work and a limited view

of the world and its possibilities are the ones who are going to have leisure, and then there is the vast group of unemployed for whom leisure is hardly attractive.(9)

With these projections for the years ahead, there are certainly challenges for industrial education.

There are many issues that need effective resolution in advanced graduate study. We have touched here on only a few.

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ACIATE business (a compilation)

Frederick D. Kagy

The highlight of the business meeting of the ACIATE at Louisville was the report of the election committee. The new officers elected this year were Dr. Donald Lux, president, and Dr. Dan Householder, secretary. Both of these men will serve the Council for two years. The carry-over officers are Dr. Paul DeVore, vice-president, and Dr. William Sargent, treasurer.

Completing their two-year terms this year were Dr. Fred Kagy, president, and Dr. Willis Ray, secretary.

Dr. Kagy will continue to serve on the ACIATE Board as past-president. The past-president also serves as chairman of the Yearbook Committee.

The membership of the ACIATE went over the 1,000 mark for the first time. The membership now stands at 1,072.

Each year the members of the ACIATE have a chance to nominate one of their members for the "Man-of-the-Year Award", for the outstanding contribution that this person has made to the profession over the years. Dr. Donald Maley was presented this award for 1970. Dr. Paul Harrison, Jr., a member of Dr. Maley's staff, made the formal presentation at the Yearbook Luncheon. Dr. Harrison related the many and varied contributions that Dr. Maley has made to the profession of industrial arts teacher education. The presentation of this award is in its 16th year. There have been 15 recipients. There has been a recipient each year except 1964.

The Council is proud to add Dr. Donald Maley's name to the distinguished list. Below are listed the recipients and the year of their recognition.

Dewitt Hunt	1955
Gordon Wilber	1956
Burl Osburn	1957
R. Lee Hornbake	1958
Kenneth Brown	1959

M. Ray Karnes	1960
Ivan Hostetler	1961
William J. Micheels	1962
John Feirer	1963
(None Selected)	1964
Rupert N. Evans	1965
Robert S. Swanson	1966
Ralph C. Bohn	1967
Frederick D. Kagy	1968
Rutherford E. Lockette	1969

One of the important meetings of the ACIATE is the Yearbook Luncheon, co-sponsored by the Supervisors' Council. This year's chairman was Dr. Ralph Steeb. The ACIATE presents the yearbook at this function. The editor for the 1970 Yearbook, number 19 in the series, was Dr. Ralph Gallington. Mr. Wes Stephens, of McKnight and McKnight Company, presented Dr. Gallington with the first two copies.

Dr. Gallington related to the members attending this function the problem an editor of a yearbook has in bringing an undertaking of this nature to completion. Dr. Gallington introduced the chapter authors: Norman Pendered, Rutherford Lockette, James Heggen, Willis Ray, Hugh Hinely, John Lindbeck and Dan Householder.

The title of Yearbook 19 is "Industrial Arts for Disadvantaged Youth". This book has brought to the profession a plan to help these students. The authors, editor and the officers of the ACIATE hope you will avail yourselves of this important work. The book is available for sale to non-members of the Council from the McKnight and McKnight Company.

The ACIATE very sadly reports to the membership the passing of two of its members: Dr. Menzo Stark and Dr. John Conaway. Both of these men have held membership in the Council for many years. Dr. Conaway has been very active in giving leadership to the Accreditation Committee. His group has prepared a tentative accreditation form for use in a self-evaluation of an Industrial Arts Teacher Education Program. His death came just a week before the Convention.

Dr. Kagy is on the faculty at Illinois State University, Normal.

representative addresses from the
major group and special interest sessions

instructional systems
(innovations and methods)

The implementation of flexible modular scheduling in industrial education

Harold S. Resnick

During the past several years, a number of innovative school curricula and scheduling patterns have been introduced, to a large degree because of recent technological advances. Perhaps the one technological device used most frequently is the computer. Computers have been used to develop sophisticated instructional programs, a number of forms of computer-assisted instruction, and for many non-instructional purposes. Flexible modular scheduling is one example of the use of the computer as a non-instructional device to broaden a school's master schedule, and to program students within it. It is a scheduling technique that allows schools to use the concept of time as a variable, rather than as a constant in the scheduling pattern.

The three words, flexible modular scheduling, define the program to a degree. The word scheduling means that FMS is a technique used to schedule students. By itself, this does nothing to create different kinds of learning patterns. It does, however, allow for different learning patterns to occur. Flexible signifies that this program allows for a greater deal of flexibility in terms of the kinds of possible learning activities, and the individualization of student programs. The term modular refers to a module of time – a single small unit, usually approximately fifteen minutes. These modules, replacing the old-fashioned "period", are the basic building blocks for the school program. Flexible modular scheduling, then, is a computer-based administrative device used to schedule the students in a school, usually within a weekly cycle, on a more flexible basis, using time as a variable rather than as a constant, and basing the school scheduling cycle upon building blocks called modules.

This report consists of four major subdivisions. First, an attempt is made to provide a general description and the supportive rationale for flexible modular scheduling, including an example of its use. Second, the background information for this study which examined the "state of the art" of the implementation of flexible modular scheduling in industrial education is provided. Third, the findings of this study are reviewed. These findings examine the total school program, as well as the industrial education area. It is believed that the range of data reported in these findings may well point out some of the limitations as well as the advantages of flexible modular scheduling. And fourth, a brief summarization and the conclusions and observations of this study are presented.

General information regarding flexible modular scheduling. Flexible scheduling is an administrative procedure that utilizes the computer in the development of the master schedule for a school, and reduces the length of the basic unit of time (traditionally known as the period) from which the schedule is built. The traditional master schedule provides for variability in scheduling students, teachers and curriculum, holding time as a constant; the flexible schedule manipulates time as an additional variable. By reducing the basic unit of time – now referred to as a module or "mod" – to approximately fifteen minutes, mods may be built upon one another in various patterns to meet the curriculum design needs of any particular course. Thus, large groups of students can be brought together for designated periods of time, small groups can be scheduled to meet with individual teachers, laboratory activities can be structured for any needed length of time, and students can have unstructured time for independent study or development.

The essence of this system can be explained best by comparing the flexible and inflexible systems of scheduling. In the inflexible system most academic subjects are typically scheduled for five class meetings per week, and classes last the same length of time, usually one hour. Although this pattern is altered somewhat in industrial education, the scheduling cycle established generally tends to be quite rigid and inflexible. The learners constantly meet the same teacher, and the same students always meet in the same class.

In the flexible system, the school day is divided into smaller modules. These modules are combined so that industrial education classes generally schedule laboratory activities for three, four or more modules. The schedule can thus allow for the specific requirements of each course and, within courses, differentiate between the different activities associated with the instruction in the subject. Large group instruction, small group instruction, laboratory and independent study can be scheduled so that different combinations of modules are allocated to each of these activities. The following description of a typical course exemplifies the curriculum changes made feasible through FMS.

A tenth-grade industrial education course in materials and processes has an enrollment of 140 students. Time allocated for this course is fifteen modules per week, which is comparable to the traditional provision (i.e., 15 x 20 minutes = 300 minutes; 5 x 60 = 300 minutes). A team of three teachers is teaching this course.

These teachers determine that part of their instruction could be provided for 140 students in one group as effectively as for twenty or thirty, with a much greater degree of efficiency. A large group meeting for all students, therefore, was designated for two modules (40 minutes) once each week. This large-group session was typically used for safety instruction, and related technical and occupational information.

In addition, two structured laboratory sections of three modules each (60 minutes) were established for each student. Twenty-five students were set as the number for a structured laboratory group. The remainder of time was allocated for unscheduled open laboratories. If three teachers were to teach this course within a traditional schedule, a total of 90 minutes per week would be required, with 46 students per course. Under the modular system, 40 minutes was set aside for large-group activity, and a total of 720 minutes was required for structured laboratory sections. This left 140 minutes per week for open laboratory activities, and reduced class size in a structured lab from 46 to 25 students. Opportunity to use the open lab provided the necessary time for additional activities for those students needing such time.

The most significant change created by flexible modular scheduling is the unstructured mod – the opportunity for each student to have as much as forty or fifty percent of his school day unscheduled so that he can independently assume the responsibility for his own learning, to complete the aim for each specific course, and to study in those areas that are relevant to him utilizing his own cognitive learning style.

The rationale for utilizing flexible modular scheduling. The present typical school schedule is based on the philosophy that it takes the same amount of time, within the same instructional pattern, to perform all instructional tasks. This is evidenced by the existence of the Carnegie Unit, and by the fact that all courses meet for the same length of time per meeting, and the same number of meetings per week, within the same instructional pattern. Yet, educational psychology and theories of learning would suggest that this is not an optimum pattern for all subjects. Not all children need the same amount of time to learn specific things. Nor do all children come to school with equal backgrounds and talents.

Flexible modular scheduling was designed to resolve these problems. Rather than prescribe a series of standard experiences for all youth, FMS changes the learning pattern so that each student assumes the responsibility for his own education. The objectives of flexible scheduling are to make students responsible for their education, and to teach them how to learn, rather than what to learn.

Basic to any educational innovation is a supportive theory of learning. Perhaps the single truism accepted by all education philosophies is the concept that people are unique, and that each person learns best in a style unique to himself, based on his past experiences. Teaching must take into account, therefore, the differences in the capacities of given individuals to absorb material. Certainly the assumption that everyone learns in the same manner is patently untrue.

This assumption provides the fundamental rationale for the development of flexible modular scheduling. The student, rather than the teacher or the school system, is placed at the hub of the learning process. If one is to accept this new organizational design, another very critical assumption must also be made: that time is not the prime criterion for successful achievement, and that learning should be measured in skills attained, rather than in hours spent in the classroom. The modular concept of course structure is predicated on the premise that those involved with curriculum planning can determine explicitly those kinds of specific learning activities students need to have in the structured phase of the program. The modular schedule is then adapted in such a manner to facilitate the types of learning experiences prescribed. Flexibility, then, is the means to an end, operating on two levels. First, the responsibility for learning is placed on the learner; and second, the school structure is redesigned to facilitate the achievement of the goals established by the learner.

Background for this study. In March of 1965, the School of Education of Stanford University submitted to the United States Commissioner of Education a proposal for a three-year developmental pilot program entitled Flexibility for Vocational Education through Computer Scheduling. This proposal was funded in two phases. The first phase was established to test the feasibility of applying computer-generated scheduling techniques to vocational education. The second phase was intended to implement computer scheduling on a broad scale, and to involve more schools and educational programs than were involved during the first year of the project. The computer schedule employed was called the Stanford School Scheduling System (SSSS). The key personnel in the development and administration of this project were Dwight W. Allen, Robert N. Bush, Norman J. Boyan and Robert V. Oakford, of Stanford University. This project terminated in September, 1968.

When the research phase of the Stanford School Scheduling System was completed, Educational Coordinates, a private corporation, was established to provide continuity to the schools using the system, and to provide service to new schools interested in this activity. At the present time, Educational Coordinates is under contract to schedule more than 115 schools, and conducts several national conferences related to flexible modular scheduling each year. Since the schools scheduled by Educational Coordinates are a highly select group, representing a cross-section of the United States, a wide range of student population and the benefit of several years of implementation, it was decided that they would serve also as the basic population for the study described in this report.

The purpose of this study was to examine the industrial education departments of schools utilizing flexible modular scheduling, and to prepare a manuscript describing the administrative and instructional procedures employed by these departments. This examination was comprised of five major procedures: 1) a review of the literature in the field of flexible modular scheduling for the purpose of identifying characteristics of existing programs; 2) selection of the schools used in the study; 3) visits to several of the selected schools to aid in the development of the data-gathering instrument; 4) a survey of the industrial education department of the sample and identification of the administrative and instructional procedures employed; and 5) the preparation of a manuscript of practices employed in these schools. It was the purpose of this document to serve as a guide in the further implementation of flexible modular scheduling for industrial education.

On October 8, 1969, an initial data-gathering instrument was sent to the principals of all schools scheduled by Educational Coordinates. The purpose of this data-gathering instrument was to determine whether each school met all criteria for the study, and also to identify an individual who would represent the industrial education department for the completion of the major data-gathering instrument. In addition, an attempt was made at this point to identify a number of individuals who would be willing to serve also on a special team to help validate the major data-gathering instrument prior to its release. Based upon this initial survey, 77 schools were identified for the study. Nine individuals, from nine different schools, were identified also to serve on the validating team. The instrument was validated during the month of December, and mailed during the months of January, February and March. A total of 65 responses were received, and the data were collated and reported. The following section describes the results of the data gathered.

Presentation of the data.

The purpose of this section is to present the findings of this study, based on the returns of the major data-gathering instrument. These results have been subdivided to correspond with the various sections of this research instrument.

General school information. It was the purpose of this section to determine the overall scheduling pattern for each school. Based upon the data returned, the length of time that the reporting schools have been using flexible modular scheduling ranges from 1 to 7 years, with an average of 2.9 years, and a mode of 3 years. The typical structure for a school day appears to be 20 mods, 20 minutes long, for a school day of 6 hours 40 minutes. Although the range of figures represented shows a larger diversity, both the average and the mode indicate that the 20-20 pattern is most common.

The Industrial Education Department. Information about the respective industrial education departments showed a much greater range of data. For example, the number of students within a given industrial education department ranged from a small rural school with 72 students to a multi-school urban complex with 1,500 students. Corresponding numbers of teachers within these departments ranged from 1 to 14.

On the average, a typical industrial education department has 435 students, served by 4.1 teachers; to approximately one teacher for every 100 students. The number of labs per department ranged from 1 to 10, with a corresponding average of 4.3, or approximately one lab per teacher and per 100 students. It was rather disappointing to note that of the 62 schools responding, only 11 had any full-time paraprofessional supportive personnel in industrial education. Of these 11 schools, all but three had one aide; the other three had two aides. In addition, 13 schools did report the use of part-time aides, ranging from 1 to 16 per department. The one school reporting 16 aides stated that these were students who served in the labs during some of their unscheduled mods.

Large-group instruction. Of the 62 schools with reported, acceptable data, 29 stated that they did not use large-group instruction, while 33 are utilizing it. Corresponding percentages reveal that only 53 percent of these industrial education departments use this instructional pattern.

It appears that the areas of woodworking, metalworking and electricity-electronics use large-group instruction at a ratio of approximately 3 to 1. For example, of the 33 schools using large-group instruction, 22 had an electricity-electronics lab. Of these 22, 16 reported the use of large-group instruction in this area, while six stated that they did not use it.

The area of power (also reported as automechanics) reported a very high ratio of large-group instructional use, with a positive response from 14 schools and a negative one from only 3 schools. Another area with a high ratio for large-group instruction was general industrial arts. While only 7 of these 33 schools reported the use of a general industrial arts lab, all seven stated that they did use large-group instruction.

All other areas reported an approximate even split between the use or non-use of large-group instruction. It was interesting to note that of all areas reporting, only drafting and graphic arts reported a higher number not using large groups, than using it. It should be reported, however, that the difference was only by one lab in each case.

In determining the administrative pattern for large-group instruction, four questions were asked: 1) how many times per week does the large group meet, 2) for how many minutes per meeting, 3) with how many students per meeting, and 4) in what type of facility.

All schools but five reported that their large groups met once a week. The other five schools reported a meeting twice per week. This produced an average of 1.2 meetings per week. The average length of time per meeting was 42 minutes, which corresponds highly to a 2-mod meeting, at the pre-determined mode of a 20-minute mod. Although the amount of students per meeting ranged from 15 to 325, the average of 91 corresponds to a combined group of approximately four structured lab sections.

The majority of these large groups meet in some type of formal large-group facility. Fifteen schools reported the use of a classroom, seven stated that they used a lecture hall, and seven reported the use of the auditorium for their large-group meetings. Only two schools reported an attempt to conduct large-group meetings in the lab, and these schools maintain an average of 35 and 40 students per large-group meeting, which is far below the average of 91.

A wide diversity was recorded in the amount and kind of equipment maintained on a permanent basis to support instruction for large groups. The single most commonly available device is an overhead projector, with 87.2 percent of the schools reporting its permanent installation. Other than this, the only items reported permanently available by more than 50 percent of these schools were a microphone (56.2 percent) and a film projector (53.0 percent). Also reported in rather substantial numbers were a film projection booth (43.8 percent) and a stage with podium (40.6 percent). To a somewhat lesser degree, 31.3 percent of these schools reported the availability and use of closed-circuit TV, whereas only 9.6 percent indicated a set of master controls for this equipment at the podium. When asked to specify other equipment not indicated in the data-gathering instrument, all responses indicated such hardware as tape recorders, opaque projectors and filmstrip projectors.

The data indicate that the most commonly used methods for taking attendance at large group meetings are roll call, the use of a seating chart, or both. The use of each of these techniques was reported by 15 schools. To a somewhat lesser degree, seven schools reported the use of a sign-in sheet, often in conjunction with a roll call. Other individual techniques for taking attendance included the use of quizzes or review questions, and the use of lab assistants or teacher aides for this function.

In reporting the subject topics for large-group meetings, the schools in this study indicated the highest percentage of time -- 41 percent -- devoted to technical information related to laboratory work. The next highest area was related occupational information, receiving an average of 16 percent. Approximately 14 percent of the time used in large group meetings was devoted to demonstrations of tools and machines; 13 percent to safety instruction; and 10 percent to evaluation. Other items indicated by individual schools included technical information not related to the lab, discussion and planning sessions, and school problems and functions.

A number of different instructional methods are employed for large-group meetings. The primary method by far is the traditional one-teacher presentation, employed approximately 62 percent of the time. Other than the traditional one-teacher presentation, the next highest rating is for the use of films. An average of all schools indicates that 19 percent of the large-group meeting time is devoted to films. The only other substantially reported method was team teacher presentations, receiving an overall average of 8 percent. Other instructional methods receiving overall averages from two to four percent included single- or team-student presentations, guest speakers and field trips. One other instructional method reported by only one school was the use of 10 percent of the instructional time for viewing videotapes of demonstrations.

These teachers were also asked to rank the method they use to evaluate the effectiveness of large-group instruction. The averages compiled indicate that laboratory performance is the most highly-considered determinant of instructional effectiveness; written test performance is considered second in importance; and large-group attendance is the least-considered factor.

The last major question for large-group instruction attempted to assess the respondents' reactions to the effectiveness of large-group instruction. Eighty-one percent of the teachers responded positively to this question, whereas only 19 percent responded in a negative manner. A number of respondents indicated a variety of suggestions to increase the effectiveness of large-group instruction. In general, these tend to fall within three categories. First, a number of teachers indicated a need for more audio-visual materials and "software". Second, and related to the first item, was the identified need for better large-group facilities, and more equipment or "hardware". Third, and perhaps most important, was the stated need for more personnel, additional teacher preparation time, and teachers trained in large-group presentation skills.

In general, it appears that the schools and teachers are reasonably satisfied with the effectiveness of large-group instruction.

Structured laboratory sections. This section attempts to answer several basic questions identified with the structured laboratory sections. The first of these questions deals with the administrative scheduling pattern and personnel utilization for the structured lab. The average scheduled lab meets 2.3 times per week. The range of meetings is only 1-5, and the mode is well established at two meetings per week, this number represented by 31 of the 61 schools with acceptable responses. The average length of each meeting is 65.8 minutes, which corresponds closely to the 60-minute mode, representing three 20-minute mods. Approximately 20 students are scheduled for a structured lab (more accurately, an average of 20.3 students and a mode of 24 students). A typical structured lab, then, will meet twice a week for three mods per meeting, and 20 students per group.

The overwhelming personnel pattern contains one teacher per meeting, and no supportive personnel. Only two of these 61 schools indicated two teachers for a structured lab, and seven identified the use of one support person.

In identifying available facilities for small group discussion, the greatest percentage (41.0 percent) of the respondents indicated the use of a portion of the lab. Thirty-two and eight-tenths percent did note the use of a separate conference or classroom for this activity. A sizable portion of these teachers (26.2 percent) reported no facilities for small discussion groups. A smaller percentage (16.4 percent) indicated the use of the resource center for this activity.

To the surprise of this researcher, 17 of these schools, representing 27.9 percent, were utilizing facilities expressly designed for flexible modular scheduling. Sixty and seven-tenths percent were in facilities that had been designed for a traditional program, and had not undergone any changes. The remaining 13.1 percent were in traditional facilities that had been modified in some manner to adapt to FMS. In most cases, these changes represented the removal of walls and/or the construction of large- and small-group discussion areas.

The next section attempted to report data regarding the typical instructional pattern for scheduled laboratory activities. By far, the greatest percentage of time is devoted to student performance at the work station. This activity accounts for an average of 59.1 percent of all structured lab time. The next highest-ranked activity in terms of percentage of time is the teacher demonstration of manipulative operations, accounting for an average of 21.7 percent of the time, with a somewhat lower mode of 10 percent. The remaining time is divided between discussion of related technical (11.2 percent) and occupational

(5.6 percent) information. Individual responses from teachers identifying other activities are most often either student evaluation or clean-up.

In ascertaining whether the general involvement of students in leadership or service capacities in the structured lab has changed under the modular system, 60.3 percent of the respondents reported no change. The 39.7 percent positive responses indicate a great range of comments. By far, the majority of these teachers report a greater student involvement, more student responsibility, self-direction and assumption of leadership roles. The general comment seems to be one of more individualization – greater opportunity for each student to develop a program to meet his particular needs. There were, however, a number of teachers who reported decreased student involvement, leadership and motivation.

The last question dealing with the structured laboratory section called for a respondent evaluation of the effectiveness of this instructional pattern. The vast majority (84.7 percent) of these teachers responded positively to the structured lab. Many teachers, including those who responded both positively and negatively, made a number of suggestions to increase the effectiveness of this instructional phase. Many of these suggestions called for longer meetings, more meetings per week, and fewer students per meeting. Some teachers indicated a need for more structure, while others expressed a desire for less structure and more flexibility. It would appear that these responses are as much a factor of each teacher's personal relationships with his students, as anything else.

Independent study - The "unstructured" mod. Of the 59 schools responding to this section, 56, representing 94.9 percent, reported the use of independent study. It would appear, therefore, that this instructional phase is an essential part of flexible modular scheduling. The first basic question in this section attempted to determine the extent of independent study in each school. This was determined by identifying the percentage of each student's time that was not scheduled, and then noting the degree of freedom he had during this unscheduled time. As shown in the data, the average student has 36.7 percent unscheduled time, with a reported mode of 40 percent. Forty of these 59 schools, representing 72.7 percent, give their students complete freedom to travel anywhere on the school campus during this unscheduled time. Those schools specifying restrictions generally specify one of three qualifications: 1) students may not roam the halls during mods, 2) students must be in areas where supervisory personnel are present, or 3) students must report to certain designated areas, usually the library, resource centers, a "commons" area or open labs.

An attempt was made also to identify those facilities available to the student for independent study. All schools responding indicated that they had a central library for student use during independent study. Seventy-eight and nine-tenths percent of these schools reported also that this central library contained resources for industrial education. A smaller number, representing 40.4 percent, specified also that they had a separate resource center for industrial education. In addition, a significant 75.4 percent of these schools reported the use of a cafeteria which served also as a student center. When asked to identify any other kinds of student centers or lounges, 27 schools, or 47.4 percent, specified some kind of area. The majority of these are open courts, patios, recreation rooms and lounges. Also included, however, are resource centers, student carrels and a paperback library.

The next series of questions attempted to provide data in determining the pattern of use for the open lab with respect to: 1) facility and staff availability, 2) kinds of activities conducted in the open lab, and 3) special organizational patterns established. There appears to be a very wide range (3-105) of numbers of mods per week that a lab is available for unscheduled activities. Both the average and mode, however, seem to settle at approximately 30, which is roughly equivalent to six mods or two hours per day. During this time the number of students allowed to use an open lab ranges from seven to "no limit". A double mode exists for this item, indicating both a "no limit" response, and a mode of 24. This mode of 24 corresponds also to the average of 24.4, and to the mode for students allowed in the structured laboratory.

The percent of students who use the open lab also varies greatly from school to school, with a range from 5 to 100 percent. It is interesting to note that although the average number of students using the open lab is 59.7 percent, the mode is 100 percent. The number of personnel staffing this lab ranges from 1 to 3, with an average of 1.2 and a very large mode (42 of 56 responses) of one. In 50 of these 56 schools, the level of this personnel is a teacher. Only six schools, representing 10.7 percent, include the use of a paraprofessional or aide. It would seem, therefore, that the staffing pattern for this instructional technique has remained rather traditional.

In an attempt to determine the percentage of student time devoted to varied activities in the open lab, a number of questions were asked. The results seem to indicate that approximately equal time is devoted to individual projects belonging to students, and directed study projects being done for student credit. These two areas received averages of 37.9 percent and 37.3 percent, respectively. In both cases it is interesting to note a mode of 10 and a range from 0 to 100 percent. The next highest area was the completion of homework or independent study assignments. This activity received an average of 19.3 percent, and a mode of 0. The other area identified, special club activities, received a rating of only 1.2 percent, and 42 of the schools reported 0 for it.

The use of the open lab by non-industrial-education students was also examined. It appears that 34 of these 56 schools, or 60.7 percent, allow non-industrial-education students to use the open lab. There are, however, a number of special considerations that need to be made for them. The prime concern seemed to be one of safety, and the IED teachers responded typically with one or more of the following restrictions: 1) they must be accompanied by an approved IED student or by the teacher while they are working, 2) they must first pass the safety tests, 3) they must be "checked out" on the equipment, or 4) they may use hand tools only.

The next section attempted to report any unique organizational patterns that were needed for the open lab with respect to attendance, tool distribution and control, safety procedures and clean-up procedures. As shown, 54.7 percent of the schools reporting indicated that they did not take attendance during the unstructured lab. Of those schools taking attendance, a sign-in or check-in sheet was most prevalent. Some schools have an official time clock, while others use a student foreman to take attendance. Seventy-six percent of these schools utilize an open-tool-panel honor system, in which students take tools as they are needed. In those few schools where this system is not being employed, a student tool foreman is generally in charge of all tools in a "crib", and he signs them out to students as needed. It was interesting to note that virtually all schools reported the same safety policies and procedures as for all other phases of laboratory activity. In no school did there seem to be deviation from this pattern. In terms of clean-up procedures, 75.5 percent of the schools use the informal procedure of each student being responsible for cleaning the area in which he was working. Those schools not using this informal procedure generally report the use of a formal system similar to the one used in the structured lab, often utilizing the aid of a student foreman.

The last basic question regarding this instructional phase was the respondents' reaction to independent study. Fifty percent of the respondents indicated that they believed that the unstructured mod had been effective; 48.1 percent responded in a negative manner, and one person said "yes and no".

The number of suggestions to increase the effectiveness of the open lab were many and varied. A number of teachers indicated the need for paraprofessional support. Some teachers complained of problems relating to clean-up and tool loss. Several teachers indicated the need for more structure; others wanted less structure. No generalizations or conclusions could be drawn.

The resource center. It was interesting to note that of the 61 schools responding to this section, only 24, representing 39.3 percent, indicated that they have a resource center for industrial education. An immediate conclusion could be drawn, therefore, that this is an area in need of further development.

The data in this section attempted to provide information regarding the administrative structure of the resource center for industrial education. Of the 24 schools containing this resource center, 10, or 41.7 percent, maintain a center solely for industrial education. The other 14 centers are shared typically with the other practical arts, although in several cases they are combined with either fine arts or math and science. The number of students that can be served in this center ranges from four to 150, with a mode of 25 and an average of 39.9 students. The typical center is open on an average of 17.7 mods per day, although the mode reported was an "all-day" availability.

In determining the kinds of equipment and resources contained within this facility, it was indicated that the most widely-housed resource is a library of technical books and magazines (91.7 percent). Also generally available in most facilities is a place to use audio-visual equipment (79.2 percent) and teacher-made instructional materials (75.0 percent). To a somewhat lesser degree, although still maintained by approximately 50 percent of the centers, are a general library area (66.7 percent), audio-visual equipment 54.2 percent), films, tapes, slides, etc. (54.2 percent), individual study carrels (50.0

percent), and drafting tables (50.0 percent). Maintained to a much lesser degree are student and teacher lounge areas (16.7 percent each). In addition, individual items mentioned by specific schools included typewriters, a keypunch machine, business machines, electrical breadboards, a spirit master duplicator, and a dial access system.

This study attempted also to determine the level of personnel that staffs this center. Eight of the reporting schools (36.4 percent) reported no use of paraprofessionals to maintain the resource center. The remaining 63.6 percent did report the use of paraprofessionals, ranging from one to 16 per center, with an average of 2.3 and a mode of one. Forty-five and five-tenths percent of the schools also reported the use of teachers to help maintain this center, either instead of or in addition to paraprofessional support. Other persons cited by individual schools included an audio-visual specialist "on call", a librarian, a full-time secretary and student aides.

The last basic question dealing with the resource center attempted to record the respondents' evaluation of the use of this facility. Forty-five and five-tenths percent of the respondents were pleased with the effectiveness of their resource center. Fifty-four and five-tenths percent were not. The majority of suggestions to improve the use of this facility centered around the acquisition of more audio-visual equipment and materials, and the further use of paraprofessional support. Those teachers reporting a resource center as part of the lab expressed a desire to establish it physically as a separate entity.

Conclusion. This last section records the respondents' evaluation of FMS in general, and identifies any noted additional problems or comments mentioned by individual respondents.

Seventy-one and seven-tenths percent of all schools reported a positive response when asked whether they believed FMS to be better than a traditional scheduling pattern. Only 13.3 percent responded in a negative fashion, and 15.0 percent said, "yes and no".

Individual respondent suggestions to increase the effectiveness of FMS in general seemed to fall within several categories. The one major problem, however, seems to be in assisting the academically-average or below-average unmotivated student. This learner is apparently wasting much of his unscheduled time, and is no better off in the flexible system than he was under the traditional plan. This is a question yet to be resolved.

Interpretation of the findings. Throughout the middle decades of the twentieth century, a number of innovative approaches have been developed in the field of education. Flexible modular scheduling may well remain as one of the more significant of these innovations. Too often, however, an approach is developed too rapidly, field-tested too hurriedly, and condemned too prematurely.

In an attempt to avoid premature evaluation prior to a fair period of experimentation and implementation, this study attempted only to report the "state of the art" of flexible modular scheduling with respect to industrial education. Its goals were to: 1) review the development of flexible modular scheduling, 2) identify and gather data from individuals representing the industrial education departments of a number of schools utilizing flexible modular scheduling, and 3) report this data to teachers in the field.

Each of the preceding sections provide supporting data and findings related to these objectives. These findings provide a base for the conclusions and observations presented here. Conclusions are defined as those comments supported by the findings and related directly to the results of this study. The section on observations reveals findings which lack sufficient data to be classified as conclusions, but were felt by the author to be pertinent to the study.

Conclusions of the study. Based on the historical review of the flexible modular scheduling movement, and on the many descriptive comments made in the data-gathering instruments, a large number of conclusions could be drawn. The researcher believes, however, that it would be more significant to examine the several subdivisions of this instrument, and to cite only the most outstanding points.

(1) Although the schools in this study were experimenting with an innovative program, the formal arrangement for industrial education has remained essentially the same. The typical industrial education department averaged 100 students per teacher, assigned one lab to each teacher, and did not rely on paraprofessional support, or utilize the concept of differentiated staffing.

(2) Large-group instruction was not used in industrial education by almost 50 percent of these schools. The conclusion could be drawn that more attention could be given to this area, either in terms of training teachers in the methodology of making large-group presentations, and/or in the development of curriculum materials to support this instructional phase.

(3) The fact that some areas within the field of industrial education use large-group instruction more than other areas would seem to conclude that different kinds of content are more or less suited for large-group instructional patterns.

(4) Despite the verbal homage paid to team teaching and student involvement and instructional aides, the pattern for presenting subject matter is still overwhelmingly a formal one-teacher presentation. The single exception to this statement is the fairly widespread use of films for large-group presentations.

(5) It would seem that a number of schools would either begin to use or increase their use of large-group instruction if large-group facilities, with audio-visual hardware and the supportive software, were more generally available.

(6) The amount of time students now meet for structured laboratory sections has been reduced from the traditional five hours to approximately two hours per week. It would seem, therefore, that the other instructional phases do provide for a very substantial portion of the total instruction.

(7) The pattern of the structured lab in FMS has generally followed the same pattern as the traditional structured-laboratory activity.

(8) Most schools give their students approximately 40 percent unscheduled time, with a large degree of freedom of activity during this period. There is a very great range of student ability to accept and use this unscheduled time. The more able student generally assumes more leadership activities and opportunities; the unmotivated student more often does not use this time to his educational advantage.

(9) The pattern of student use of the open lab varies so greatly that it would seem this is a function of each individual teacher and his program, rather than a function of the modular system.

(10) The organizational patterns in the open lab with respect to safety, clean-up, tool usage and attendance appear to rely most heavily on a student honor system. The wide range of satisfaction and dissatisfaction with this system would indicate that this is also more a factor of each individual teacher's relationships with his students than anything else.

(11) There is a lack of adequate paraprofessional support and differentiated staffing patterns in all instructional phases.

(12) The concept of the resource center is not being implemented on a wide scale, as evidenced by the low percentage of schools containing such a center for industrial education, the poor staffing patterns and the paucity of educational materials.

(13) The general pattern for industrial education within FMS included one large-group meeting for two mods per week; two structured labs for three mods each per week, greatly resembling a traditional lab approach; and the use of open labs. Paraprofessional support, a resource center, experimental curricula, and all other innovations, then, seem to be a factor of each individual school and industrial education teacher.

The author's observations. In conducting this research, several observations were made, based both on the review of the literature and the data obtained from the research instrument. Although these are not directly or conclusively supported by the findings, there was sufficient support to warrant their inclusion in this section.

(1) While flexible modular scheduling appears to have done much for the above-average student, the unmotivated learner has trouble using his unscheduled time wisely, and is frequently unable to cope with the freedom provided by this system.

(2) Only a positive attitude on the part of the teacher can make the modular schedule a flexible schedule. Flexibility lies within the ability of each teacher to use the added variable of time to a positive instructional advantage. Innovation can occur only when it is implemented by innovators.

(3) The implementation of FMS means little without an accompanying curriculum revision. And, this revision must replace the old criteria of time invested in the classroom by performances achieved by the learner. Only when the performances are specifically identified can the best instructional patterns to achieve these performances be determined.

(4) While small-group discussion has assumed the very different function of group interaction and total individual involvement in other subject areas, there appears to be little of this change in industrial education. It is the author's belief that this is due to the great deal of informal student-teacher individual involvement that has always existed in industrial education.

(5) The fundamental assumption underlying flexible modular scheduling is that the student should assume the responsibility for his own learning. If this assumption is accepted, then the observation may be made that the heart of FMS is the independent study –

for this is where the student may develop at his own pace, using those resources of most interest to him – this is where he may discover "how to learn", rather than "what to learn".

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Modular flexible scheduling—a reaction

Kenneth R. McLea

I count this a special opportunity and pleasure to react to an innovative program such as modular flexible scheduling because of my involvement over the past couple of years in visiting schools and talking to people.

There is one phase of modular flexible scheduling, though, that I feel is an important area of this or any other innovation that needs our additional attention. The area I will speak about is especially important, since this meeting provides a hearing by people who are in a strategic position for affecting educational processes significantly. You who teach in industrial education – whether industrial arts, vocational, occupational or technical – play a crucially inportant role. And you, the teacher, are the area to which I would like to direct my reaction. You are the most important aspect in modular flexible scheduling, which is being implemented into our schools. Improve curriculum, improve teacher training, improve administration if you will, but in the final analysis, it is the teacher in the classroom upon which the better world will be molded.

Innovations abound in education, but so do teacher apathy and indecision. Whether some of the changes are truly innovative and inventive, or merely modifications of someone's creative idea, is not a basic issue. A few teachers seem to accept change for the sake of change, a few seem to be willing to be pioneers and experiment with new ideas, and fewer still are really innovators. The greater majority of teachers seem to be somewhat aware of innovations, but they react differently as they tend to follow a course of non-involvement. Modular flexible scheduling is such a case in our changing educational world, and the teacher is the most important key, and it is to you that the parents, students and (believe it or not) the administration are looking for the skills, knowledge and attitude needed for implementation and success of modular flexible scheduling.

The first step, of course, to implementing any innovation is to act now. There is no time like the present. And this is how I feel toward modular flexible scheduling and innovations. But how do we act? We study, we develop and then we implement it into a program. Even if it's only a pilot program--it's a start.

Things have changed--there is no time like the present to act. Americans are watching and waiting for their educators to "get off the stick". May I quote from a speech made to a Phi Delta Kappa meeting by an assemblywoman from the state capitol in California? I'm sure the feeling is national: "The schools in this state do not know where they are going, why they are going there, or how they are going to get there. A new joint legislative committee was appointed, whose mission is to find out the where, why and how of schools. This new legislative attitude opens the doors for all educators to make their respective cases forcefully and compellingly."

I remember last year when I was department head in a large inner-city high school. The downtown administration was asking for plans so they could completely rebuild our facilities in the industrial education department. The teachers came up with suggestions such as lockers, blackout shades, a drinking fountain, fix the door, etc. This was all that seemed to bother them. If this attitude was changed, then maybe some of the problems are ours--the teaching staff. Have you ever tried to get teachers to agree on something--anything, at a teachers' meeting? We hear a lot of complaining, but are we (by we, I mean those of us who are down on the firing line) trying to match the complaints with action?

The modular flexible scheduling program is a tough program--it takes a lot of planning, coordination, cooperation and communication between teachers and administration; students and administration; students and teachers, administration and parents. During a visit, one and one-half years ago, to a high school in California with the coordinator of modular flexible scheduling, he stated that the decision to go on modular flexible scheduling was made by the teachers, because they felt that under the regular system an effective job of educating the children was not being done.

During a visit last week, after 18 months on the modular flexible schedule, the coordinator and industrial arts department head expressed the opinion that the scheduling system needs modifying. F's have increased, cutting has increased, and they feel that they are losing 35% of the students who don't even bother to attend class. Reason--lack of motivation.

After listening for an hour or so, I found that a lot of their troubles are the same ones being expressed in schools under a regular schedule. Point: Modular flexible scheduling in itself is not a panacea--it is only an answer to scheduling problems. Student problems still exist.

So, I feel that now is the time to involve ourselves in a really in-depth study of the learning process. Did we develop modular flexible scheduling and forget the human aspects? Example--They call modular flexible scheduling new, but then still put the kids into large groups and talk to them or show films. This is new? The industrial arts kids reject it and cut the lectures in droves. After all, which is more interesting--meeting your girl out on the lawn or attending a lecture? Problem--getting them to class (administrative? or teacher?). Industrial arts problems expressed: stolen tools, liability for visitors in your shop, absenteeism, stolen books. But these could be problems under any system. We must be enthusiastic and act. We must be flexible--willing to try--willing to put in extra time and effort. Don't implement modular flexible scheduling and quit. Teachers should be working harder, but the teachers I spoke to stated that they were through at 1:30 daily, and perhaps that's why the kids don't attend afternoon classes. If a lot of teachers can leave, why can't the students?

We in industrial education must pick up the ball--NOW (as they say)--and run with it or lose industrial education completely. To the other side--the ''Academaniacs'' who still regard the soiled hand as the mark of a slave or serf – they forget or ignore the fact that the head is helpless without an educated hand. Statistics show that for every architect, we need 20 bricklayers, 20 carpenters and 10 plumbers. But they still talk about everyone going to college to be that ''architect''. Clark Kerr, ex-president of the University of California, in the news recently, wants everyone to attend college. My case--article in the San Francisco Chronicle, Thursday, April 2, 1970--''Job Squeeze for College Graduates.'' The lead paragraph states that June college graduates ''have fallen on hard times''. When is industrial education going to cease being a basement activity?

You men sitting here are receptive and interested. But how much of what you see and hear at this conference will be shared with your colleagues? Do you have meetings to convey this information? If you say ''yes'', great. If you say ''no'', then everything said or seen this week is lost. I have a favorite word which has always helped me, and I've always passed it on to my students. The word is involved. We hear, ''Don't volunteer, don't be a square.'' But how can we get things accomplished if we don't volunteer and get involved?

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The method hang-up in industrial arts

Lawrence S. Wright

I want to introduce my topic with an old bromide of which I first learned back in the late forties when I was helping with that edition of the Manual for Navy Instructors. I don't know whom to credit with the statement, and perhaps all of you have heard it. It goes like this:

There are two great sources of waste in education:

(1) Teaching the wrong thing brilliantly.

(2) Teaching the right thing poorly or ineffectively.

The first of these sources of waste, teaching the wrong thing brilliantly, deals with hang-ups related to content; the second, teaching the right thing poorly, with hang-ups related to method. Although my focus tonight is on method, I must first identify a content hang-up, because content and method are inextricably woven together as the impact of the teaching-learning process hits the learner; we can only consider them separately at the theoretical level.

This leads me to the first hang-up without which method may have no meaning: Failure of the profession to identify the source of the body of knowledge. As a profession, we are still divided into several camps with respect to the prior question of: "What is the source of our content?" or "What shall be the body of knowledge?" A review of fifteen of the innovative programs shows the following as recommended sources: Industry, technology, industry and technology, industrial technology, American industry, the world of work, productive society and occupations.

Possibly, it is too much to ask that industrial arts teachers in our secondary schools give great parts of their time to this question--but it certainly isn't too much to expect from those of us who prepare these teachers. I refer here both to the professional and to the substantive area teacher educator. Until we, as a profession, more clearly identify the source of the body of knowledge and clearly establish our rationale, we will continue to have a basic content selection hang-up which will plague us no matter what methods we choose for imparting the subject matter.

The methods we use as teachers are the vehicles or carriers through which we try to bring about our ends; namely, behavior changes in our students. Perhaps, then, the method is the medium and the message is the content and the end product is behavior change.

In choosing teaching methods (e.g., vehicles and carriers) to reach certain goals, such considerations as needs of the students, nature and scope of the course content, the ability and preference of the teacher are used. But, what is method?

Webster says that "method" is: "a systematic plan followed in presenting material for instruction."(1)

Another definition is "an ordered system by which a teacher puts educative agents to work on humans to produce certain changes or results."(2)

Harry S. Broudy writes that: "...method refers to the formal structure of the sequence of acts commonly denoted by instruction."(3) He goes on to state: "The term covers both the strategy and tactics of teaching and involves the choice of what is to be taught at a given time, the means by which it is to be taught, and the order in which it is to be taught."(4)

For our discussion, then, method is the strategic structure, or plan, for bringing about behavior changes in students. Teaching methods are the particular tactics or vehicles used to accomplish the particular end for a given student or set of students.

Whenever teachers step before their classes, whether they are first-year teachers or experienced professionals, they are confronted by the problem that has challenged educators for centuries, namely, how to teach.

Let us now assume appropriate content selection and discuss the second great source of waste in education: teaching the right thing poorly or ineffectively.

The next hang-up: The problem of failure to perceive the significant elements of the communication process is central to this discussion.

Beyond his basic survival needs, one of the earliest derived needs of man, when he began to see that it might be advantageous to work together with other men, was his need to communicate. The process of communication between two individuals is extremely complex. Encoding, sending, receiving and decoding are the elements of the process, and it can break down through any one or all of these steps. Internally, each of us has had his own unique set of experiences. The problem then becomes one of how to encode and send, with my particular set of experiences and ideas, so that you, with your own, will receive and decode the message with the meaning that I intended.

Our hang-up comes as the result of making our encoding and sending decisions in terms of the sender's rather than the receiver's experiences. Have you ever sent a student to the library or to the office for something and he brings back not what you thought you asked for but what he thought you asked for? This has probably happened to you when you have asked a student to bring you a certain tool from the tool panel. In each individual case for each student, the teacher must be able to discern whether he can simply call for the tool by name or whether he must explain to the student what it is or in what location it may be found.

Even in written communication it is usually not enough to write so that only you can read or understand it. Those of you in drafting are especially aware that the notes and dimensions on a drawing must meet the tests of both legibility and intended meaning.

The hazards of oral communication may be even greater since all too seldom is there feedback that permits the sender to know whether the intended receiver has received and, if so, what message he actually received.

This phenomenon is compounded further as one deals with groups. You are faced with a room full of students, each with his own set of internalized experiences. The messages you send out must be encoded and sent in terms of the individuals in the room, or the intended result will not take place. Especially when the bell rings and we orally give an assignment in haste are we likely to find that the intended receivers (1) either did not receive, or (2) may have received something we did not think we were sending.

When students are in groups, they must be treated with the same respect with which you and I would want to be treated. As teachers, we need to recognize more fully the significance of learning of the things going on around us in the learning environment. Students tend to learn best in a warm supportive atmosphere where their social needs are not challenged. When a student responds and is cut down, he withdraws and fails to respond in the future. Even when a student asks a question that has just been answered, the wise teacher will simply answer the question. The student probably should have been paying attention, but his question tells you that you were not communicating. Your response will have considerable bearing on whether you may be able to communicate in this group situation in the future.

When we give demonstrations, it is often done on a subject with which we have become very familiar. We may not realize that the learner's set of personal experiences is such that it was not as clear to him as it was to us. The student does not ordinarily ask questions unless something is not clear. And remember, too, the student may not be able to ask what appears to you to be an intelligent question. Try to understand what the questioner really is asking. Then answer simply and directly.

Let me turn briefly to the third hang-up: Failure to place the student at the center of the teaching-learning environment. Each of us rather enjoys being in the spotlight, especially if we think we are looking pretty good to those who see and hear us. This seems to be a characteristic of many people and of teachers in particular. It leads to another method hang-up, for it is the student who should be the center of attention, while the teacher remains on the sidelines. We tend to use those teaching tactics that permit us to show off. We seem to like to give demonstrations, especially those for which we are well prepared, and we take justifiable pride in a job well done. The law of success tends to help us perpetuate the teacher giving all the demonstrations, when we might create additional interest and possibly more learning by occasionally helping a student learn to give a demonstration. It seems to follow that success with teacher-given lectures and demonstrations may be a deterrent to the use of other tactics that more clearly put the student at the center of the teaching-learning environment.

This leads us to a fourth hang-up: Failure to use differentiated teaching tactics. We have used the project method in industrial arts as one of the main vehicles for instruction since the turn of the century. This has been and is one of the methods of providing meaningful experiences for our students and, of course, the watch words have been "learning by doing". There seem to be at least two problems with which we are faced in the project method. One is that we don't exploit the true meaning of project and really make it an educational project. Webster defines the project as: "a task or problem engaged in, usually by a group of students, to supplement and apply classroom studies." All too often, the project method turns out to be a "make-a-take-home-product" method. Such a product tends to become the end rather than the means, and, no matter how hard one tries to argue, it is difficult to deny that the end was the completed product on display at school or at home rather than the means. Dr. Lockette of Trenton State College has said: "It might be better if we could throw the project down the drain like the chemicals in the chemistry lab, since it is the process, not the product, that is significant."

The project method still has and will continue to have a prime place in industrial arts, even though we criticize various aspects of it. Properly conducted with student involvement in planning, design and evaluation, it can be a real educational project.

This brings us to the second problem associated with it. In selecting "projects" for students to pursue, just how much activity with the project is necessary before the law of diminishing educational returns sets in? This question should be answered for each proposed project, and only those that capitalize on the achievement of important behavioral changes in the student should be permitted. In some ways, the project has been a means of promoting inefficiency in learning in our shops and laboratories. All too often there have been operations that have been extremely repetitive and which, after a point, do not contribute to new learning for the student. Many of the larger woodworking projects in classes for industrial arts students would fall into this category.

We are acquainted with questions that have been raised about student-planned experiences. When students plan experiences, they will probably take longer, and they may not come off quite as professionally, but behavior changes may be more likely to occur and student insights to deepen through involvement. Sometimes in my own classes I am so impatient to turn on my teaching mechanism that I have to remind myself that classes are somewhat like the TV set: A warm-up period is required before the action can start.

Many industrial arts teachers have never considered that because the project has held such a prominent position in our instructional strategies, it has helped to limit enrollments in our classes. There are students for whom learning by this type of activity is very difficult. By the same token that some students have academic difficulty, some experience performance difficulties. We want to participate in those activities in which we can experience success, so students will go where the action is for them.

We have not done enough with providing differentiated methods for different students. We have seemingly always known that students in our classes are individuals with differing needs, but we have not had nor taken the time to allow students to use methods appropriate to them to achieve given objectives. Benjamin Bloom, in a paper on "Learning for Mastery", writes:

> We have fallen into the 'educational trap' of specifying quality of instruction... in terms of group results.... We may start with the very different assumption that individual students may need very different types and qualities of instruction to achieve mastery.... It seems reasonable to expect that some students will need more concrete illustrations than will others; some students may need more examples than do others; some students may need more approval and reinforcement than others and some students may even need to have several repetitions of the explanation while others may be able to get it the first time.(5)

We need to study how to select the best teaching tactics for different individuals or maybe how to develop a series of tactics to be selected by individuals, so that each may most efficiently accomplish the desired behavioral change.

Time permits me to turn to one more hang-up: Natural resistance of humans to change. Humans are noted for resisting change. This statement is not unique to teachers, but it certainly is characteristic. It is easy to continue with the old, while it is time-consuming and often frustrating to try something new. Change involves risk of failure, risk of locating and being confronted with new problems, and the need for thinking and planning. Many of us have used or heard one of the following change resistors:

"It won't work in our school."
"The other teachers won't like it."
"It's too much change."
"The students won't want it."
"It takes too much time to implement."
"We just changed it last year."
"We don't operate our present program efficiently yet."
"Let's form a committee."

Perhaps it's for reasons like these that we do not try some of the newer ideas or that we don't try again some of the older ones.

The question is really, "What will be the best strategy to use in terms of the student?" We each have our favorite strategies and tactics. Even so, we should be professional and improve our tactics so that when one we don't like is really more appropriate for the student, we can use it. Have your students used role-playing lately? Brainstorming? Have you used a guest speaker? A field trip? Have you had a panel discussion? A committee hearing? A board of directors meeting? A design conference? After all is said and done, the real direction the schools will take lies in the hands, not of the administrator, the school board, the guidance counselor, but squarely in the hands of the teacher. With respect to industrial arts, it will largely be your decisions that determine the effectiveness of the instruction in your facility. "A discerning and dutiful teacher will test, evaluate and finally select the technique that will most effectively convey his particular message to a certain group of learners. It is the teacher with such a variety of methodology who is best prepared to meet the daily challenge of reaching other minds."(6)

FOOTNOTES

(1) Webster's Seventh New Collegiate Dictionary, Springfield, Mass.: G. C. Merriam Co., publishers, 1965. p. 533.

(2) Coleman, John E. The Master Teachers and the Art of Teaching, New York: Pitman Publishing Company, 1967, p. 7.

(3) Broudy, Harry S., Chapter 1, "Historic Exemplars of Teaching Method," Appearing in Handbook of Research on Teaching, Edited by N. L. Gage, Chicago: Rand McNally & Co., 1963, p. 3.

(4) Ibid.

(5) Bloom, Benjamin S. "Learning for Mastery," UCLA Evaluation Comment, Center for the Study of Evaluation of Instructional Programs, Vol. 1, No. 2, May, 1968, p. 6.

(6) Coleman, op. cit., p. 5.

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The Daily Double

Jarvis Bailiargeon

We are on the track and this is a horse race. The payoff for this race is not dollars, but effective and efficient instruction in the general shop.

The general shop, which began in New York State in the early 1930's, today offers instruction to some 250,000 7th- and 8th-grade boys in New York State alone. The general shop – the bane of the unit shop teacher, a six-ring circus ("You can't teach all those areas!") – is the answer to general education in technology. This presentation is based on an article entitled "A Good Bet: The Daily Double in the General Shop", published in School Shop, October, 1968.

Historically the teaching of two activities at one time is an extension of common practices in many unit shops. The difference here is the offering of instruction in two different areas to provide activity for students at the earliest possible time. I struggled with the thought that I might practice what I preached and offer two lessons to the group represented here. Since everyone should improve on past performance, I have outlined three lessons for today:

Lesson #1

Title - Teaching General Shop.

Objective - Differentiate between a general shop organization and a general shop facility

Content - Two approaches.

Despite all the books and articles written on the subject, there always has remained a question as to exactly how the teacher was to present six activity areas as part of an instructional program. In general, it would seem there are two schools of thought:

(1) Six areas should be treated as separate entities and offered on a rotating basis as a series of units of instruction. This type of organization has many implications, as it implies that a class of 20 students will be working together in a series of instructional units carried out in a single facility.

(2) The second approach follows the line that instruction should be offered in all the separate units at one time. Teach them all at once and you have a comprehensive general shop.

Summary - In order to provide a six-activity-area general shop experience, you may: (1) Rotate total group through six consecutive packages; or (2) teach all areas at one time. We will discuss another alternative later.

Lesson #2

Title - Reviewing Daily Planbooks.

Objective - Distinguish between:

(1) Unit lesson sequences
(2) Lesson rotation
(3) Individual instruction

Content - Examine a teacher's daily planbook to:

(A) Note that all lessons are sequential in one activity area, such as woods, etc.

(B) Note that lessons are rotational from several areas. Check records to find out how the teacher schedules each student in each area.

(C) Note the prevalence of "W's", indicating that following an introductory talk, the teacher became a project construction assistant.

Summary - Check the planbook for: (1) Sequential lessons, (2) lessons from several areas or (3) very few lessons.

Repeat - Next we will discuss another alternative.

Lesson #3

Title - Daily Double in the General Shop.

Objective - Introduce instruction by presenting two short lessons in two different areas.

Content - Select two activity areas, each of which offers sufficient work stations for about one-half the class size.

(A) Begin instruction by presenting a short "how to"-type lesson from each of the two selected areas to the entire class.

(B) Following both lessons, offer student the choice of beginning actual work (i.e., selection and layout) in either area.

(C) Control choice if necessary to divide efficiently.

(D) Note for students that they will be working in the other area at a later date without additional group instruction.

Summary - Two areas of instruction - a "Daily Double" - presented consecutively during the same class period to the entire group. Capitalizing on the relatively short interest span of early adolescence, teach two short (10- to 15-minute) lessons to an entire group, followed by a division, each half of the class going to work in a different activity area.

In the parlance of the 'Improvement of the Breed' industry, we have progressed from a 'Daily Double' to an 'Exacta' (three in a row) in less than 20 minutes. The lessons can be construed as coming from three areas; Lesson #1, Undergraduate Methods; Lesson #2, Supervision; Lesson #3, In-service education. All these for the purpose of improving instruction via new teaching methods.

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Industrial education: the rumble seat and the wandering wagon

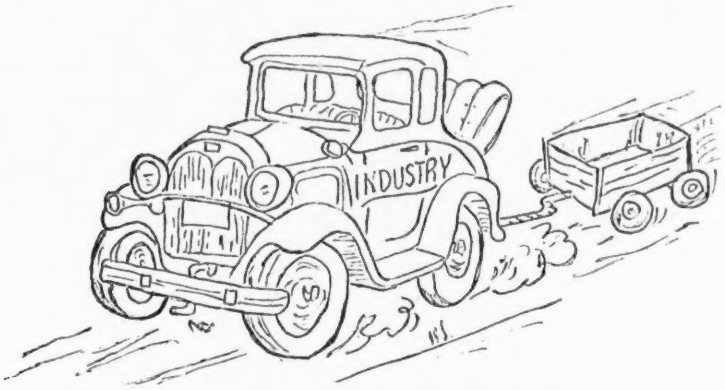
W. Lloyd Gheen

Since 1928, the objectives espoused by our national organizations have retained a relative conceptual and structural consistency (1). Changes have been made in wording and emphasis to correspond with industrial and technological changes, but basic conceptual threads can be traced throughout (2). In a recent publication, we find that to "Develop Problem-Solving and Creative Abilities Involving the Materials, Processes and Products of Industry" is one of the five "Goals for Contemporary Industrial Arts Programs" (3).

It is a fine thing to have an objective. But that goal only becomes significant if its achievement is measurable and edifying.

As a profession, we bear the title of industry. But, do we represent industry by our objectives? Let's see if a positive correlation can be drawn between industry's interest in the development and use of creative talent, and our objective to stimulate that same growth.

General Electric, for more than 25 years, has given incoming engineers a two-year course in creative thinking. As a result, these men produce three times more patents than those who do not take the training. IBM, US Steel, General Motors, the Air Force are among other major industries providing creative training for their employees. More than 6000 other companies have engaged in creativity training. Why? Technological advances amass such a tremendous amount of new knowledge in such short periods of time that it is physically impossible for one to digest it all. Therefore, the ability to think new becomes more important than the ability to digest the old. From the above evidence, it appears that our objective to develop creative talents is in close harmony with industries' needs.



In this drawing, industry is represented by an old clunk of an automobile rather than by a modern space vehicle or speeding rocket. Such a representation is not to imply industrial obsolescence, but rather to illustrate that the rapidity of technological advances will render today's industrial activities as tomorrow's clunkers.

Industrial education, and indeed the whole educational spectrum, will always be trailing industrial and technological advancement. Many of the reasons for this lag, I'm sure, are quite obvious. But, will we be trailing in the "rumble seat" position of close-quarter behindedness, or will we be slamming around in the dust of past tradition and bygone days in a "wandering wagon" fashion, making milk stools and funnels?

I have recently completed a research project which was aimed at determining (1) how much encouragement and stimulation for creative development we should, as industrial educators, provide in college classes, and (2) how well we are doing to meet these criteria.

To accomplish this task, a scale was developed containing instructional methodologies for stimulating creative thinking. The instrument, entitled "Creative Expression Scale", was then sent to 37 industrial educators throughout the nation. These experts in the field were asked to indicate the extent to which industrial educators should employ the techniques implied by the 32 items of the scale. A remarkably consistent response to the CES was received from 29 educators. Mean scores, based on a five-point scale, were calculated for each of the 32 items. Items were grouped into four sections for which additional mean ratings were established, and a "CES Mean" was determined for a collective, overall rating. These mean ratings, ranging in value from 2.62 to 4.79 (5.00 being the highest possible value), constituted "Criterion Ratings"--minimum acceptable standards for performance.

The CES was then administered in 48 industrial education classes within five Texas institutions having industrial arts teacher training programs. A total of 23 different teachers and 749 student responses* were involved in the study.

Mean ratings have thus far been established for each institution. Collective mean scores have also been computed for classes of a laboratory orientation as well as for nonlaboratory-type courses--theory classes. The means derived from the university

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*A given student could have responded to the CES in more than one class. Each separate answer sheet received constituted a "student response".

TABLE 1

Statistical Analysis of Five Institutions Showing
the Difference Between the Criterion
and the Status Ratings

Variable Number	Criterion Value	Inst. 1	Difference	Inst. 2	Difference	Inst. 3	Difference	Inst. 4	Difference	Inst. 5	Difference
1	4.72	3.20	1.52**	3.37	1.35**	3.49	1.23**	3.63	1.09**	3.61	1.11**
2	4.65	3.37	1.28**	3.66	0.99**	3.83	0.82**	3.91	0.74**	3.88	0.77**
3	4.51	2.91	1.60**	3.15	1.36**	2.97	1.54**	2.97	1.54**	3.27	1.24**
4.	4.79	3.03	1.76**	3.27	1.52**	3.14	1.65**	3.97	0.82*	3.02	1.77**
5.	4.00	1.44	2.56**	1.77	2.23**	2.54	1.46**	3.66	0.34	1.90	2.10**
6	2.62	0.71	1.91**	0.87	1.75**	1.53	1.09**	1.31	1.31**	1.27	1.35**
7	4.34	1.85	2.49**	1.80	2.54**	3.49	0.85*	2.88	1.46**	2.21	2.13**
8	2.69	0.77	1.92**	0.77	1.92**	2.37	0.32	1.47	1.22*	1.02	1.67**
9	3.03	1.66	1.37**	1.84	1.19**	1.30	1.73**	3.34	-0.31	2.20	0.83*
10	3.59	1.58	2.01**	1.46	2.13**	2.28	1.31**	1.94	1.65**	2.05	1.54**
11	2.76	1.01	1.75**	1.28	1.48**	1.37	1.39**	0.91	1.85**	1.60	1.16**
12	3.52	2.04	1.48**	1.95	1.57**	1.88	1.64**	2.47	1.05*	2.25	1.27**
13	4.07	1.00	3.07**	0.87	3.20**	2.88	1.19**	1.72	2.35**	1.29	2.78**
14	3.83	1.95	1.88**	1.38	2.45**	2.44	1.39**	2.38	1.45**	2.26	1.57**
15	3.00	1.54	1.46**	0.64	2.36**	2.00	1.00*	1.12	1.88**	1.33	1.67**
16	4.72	3.19	1.53**	2.55	2.17**	2.93	1.79**	3.44	1.28**	3.07	1.65**
17	4.59	2.86	1.73**	2.51	2.08**	3.39	1.20**	4.19	0.40	3.04	1.55**
18	3.95	1.80	2.15**	2.05	1.90**	2.19	1.76**	2.59	1.36**	2.06	1.89**
19	4.08	2.54	1.54**	2.91	1.17**	2.37	1.71**	3.88	0.20	2.79	1.29**
20	4.22	2.51	1.71**	2.71	1.51**	3.33	0.89*	4.50	-0.28	2.69	1.53**
21	4.29	2.21	2.08**	1.38	2.91**	3.30	0.99*	2.06	2.23**	2.09	2.20**
22	4.71	2.61	2.10**	2.59	2.12**	3.59	1.12**	4.16	0.55	3.00	1.71**
23	4.33	3.32	1.01**	3.37	0.96**	2.49	1.84**	4.00	0.33	3.65	0.68*
24	4.55	1.39	3.16**	1.12	3.43**	3.09	1.46**	2.38	2.17**	1.68	2.87**
25	4.55	2.66	1.89**	2.57	1.98**	2.75	1.80**	3.62	0.93*	2.88	1.67**
26	3.83	2.56	1.27**	2.33	1.50**	2.84	0.99*	3.28	0.55	2.52	1.31**
27	4.55	2.81	1.74**	3.01	1.54**	2.91	1.64**	4.37	0.18	3.22	1.33**
28	3.66	0.96	2.70**	1.21	2.45**	1.74	1.92**	2.22	1.44**	1.51	2.15**
29	3.17	1.69	1.48**	0.95	2.22**	2.28	0.89	0.94	2.23**	1.94	1.23**
30	3.83	1.99	1.84**	1.47	2.36**	2.77	1.06*	2.75	1.08*	2.38	1.45**
31	4.16	2.20	1.96**	2.02	2.14**	2.07	2.09**	3.19	0.97*	2.63	1.53**
32	3.31	2.11	1.20**	1.83	1.48**	3.16	0.15	2.38	0.93*	2.58	0.73
Stud.Expan.	4.04	2.36	1.68**	2.54	1.50**	2.77	1.27**	3.24	0.80**	2.73	1.31**
Tea.Encour.	4.11	2.08	2.03**	2.11	2.00**	2.90	1.21**	3.06	1.05**	2.39	1.72**
Procedure	3.93	2.09	1.84**	1.81	2.12**	2.59	1.34**	2.70	1.23**	2.26	1.67**
Technique	3.63	1.79	1.84**	1.50	2.13**	2.40	1.23**	2.30	1.33**	2.21	1.42**
CES Mean	3.96	2.11	1.85**	2.02	1.94**	2.68	1.28**	2.86	1.10**	2.40	1.56**

** Significantly different at the .01 level
* Significantly different at the .05 level

survey comprise the "status ratings"--actual in-class encouragement for creative development.

The status ratings for each institution, and for laboratory and nonlaboratory-type courses, have been statistically compared with the corresponding criterion ratings. The Dunnet procedure was used to make this comparison (5). Table 1 illustrates the results of the institutional analysis. Every variable for institutions one and two was significantly below the criterion ratings at the .01 level of confidence. The analysis for institution three revealed that although all 37 ratings were below the criterion means, the values for items 8, 29 and 32 were not significantly different. The two negative differences for institution four indicate that student activities in course planning and the encouragement of "originality" surpassed the minimum standard. The above analysis leads me to conclude that, generally speaking, the industrial teacher training programs sampled are not providing sufficient creative stimulation in their instructional methodologies. And although this assumption cannot be statistically generalized for all schools and classes, it is my hypothesis that these same basic results would exist throughout the profession, with few exceptions.

The analysis of differences which arose from comparing laboratory and nonlaboratory ratings with the criterion ratings showed a consistently significant inadequacy (.01) in both areas. As you might suspect, however, laboratory experiences were generally a little more creative in nature. Exceptions to this were encountered in the areas of student self-evaluation, student participation in planning parts of the courses, speculative reasoning, deferring judgment, and teacher help in coping with failure. I wonder if this last item, helping students cope with failure, suggests that in our labs we give students the feeling that "if you're all thumbs, pal, there just isn't much hope"?

Typically, it appears, industrial education concentrates greater efforts in passing on information--pouring knowledge into--than it does on the generation of new ideas.

Industry calls for creative talent. We acclaim its development through our professional objectives. Yet, research has shown that we are not concentrating sufficient efforts toward nurturing this much-needed ability. I suggest we reexamine our performance and apply devotion to a cause--the cause of encouraging greater creative performance from the students in our own classrooms.

Business and industry call for ideas, make efforts to pull ideas out of the employees at all levels. Suggestion boxes have been used for years. Have you ever thought of using a suggestion box, in effect, in your teacher training classes? Have you been fortunate enough to have been challenged to contribute a "suggestion" in any of the classes you were in as a student? Let's not fool ourselves by merely carrying the title of industrial arts. Let's act to challenge the thinking of our future industrial arts teachers. Let's pull for ideas, and bring our profession nearer to being industrial education.

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New industrial arts for the senior high school: relevance in a dynamic age

Donald Maley

> "...We can no longer afford the kind of formalized education which takes the child into the future with his gaze fixed steadfastly on the past. Somehow we must convince our patrons that it is more important to help the child to think about the next civilization than to require him to remember the facts of the last one." (11, p.24)

This presentation deals with a projection of a new role for industrial arts at the senior high school level. And, incidentally, the precise terminology to describe the program or phase of education may appear as something different from the present industrial arts.

The proposal in this discussion grows out of a number of concerns, which I will present as questions.

(1) What is the role for industrial arts at the senior high school level as man moves into the Twenty-first Century?

(2) What is the role for industrial arts in a post-industrial society?

(3) Where can we best place our emphases in a curriculum area that is devoted to the study of industry and technology?

(4) How and where can a program at the high school level establish relevance with

the students and the world about them?

(5) From a purely educative process, where can industrial arts (or some other appropriate title) place its major emphases when dealing with students who will live their lives in the dynamic, ever-changing, complex and somewhat unknown world of tomorrow?

No attempt will be made to deal with each of these questions completely. They merely serve to identify the nature of some of the agony that a sincere and challenged individual has been experiencing. They also serve as a catalytic element toward moving industrial arts out into the mainstream of education and of society in general.

The work on the proposed senior high school program by some of the staff at the University of Maryland grew out of their own multiple concerns as earlier expressed, in addition to persistent requests from high school teachers across the country for new and relevant programs. The time and the need for action in this area appeared long overdue.

The existing high school programs have not had any kind of professional consensus with regard to direction, substance or even association with a definition. Through its unit laboratory organizational patterns, the high school program has been dominated by specialized subject or content development as well as by a form of pseudo-vocational preparation.

The programs have been narrow in their appeal to students and have not provided the broad-base general education framework so often espoused or advocated.

It is my hope that industrial arts teachers at the senior high school level would aspire to a place in the mainstream of education. The potentials for an increasingly important role in education are greatly enhanced as man turns increasingly to technology in the solution of his most pressing problems. The great void in contemporary education exists in the area of understandings that separate the technologists from the vast majority of the populace. Here is a vital, dynamic, challenging role, and I bid you to venture into it with a zeal equal to the urgency of the task.

I also bid you to move out into the mainstream of life with a form of education that focuses on the future.

Thus my first reference point leads me to urge you to consider a future-oriented form of program. As such, it would be a form of education that is engendered in the present, but in reality must be a thrust into the future. The nature of this present-future orientation in education is best expressed in the following quotation:

> 'Time,' said St. Augustine, 'is a three-fold present: The present as we experience it, the past as a present memory, and the future as a present expectation.' By that criterion, the world of the year 2000 has already arrived, for in the decisions we make now, in the way we design our environment and thus sketch the lines of constraints, the future is committed. ...The future is not an overarching leap into the distance; it begins in the present. (1, p.1)

The major problems facing mankind in the present may in fact provide the educational springboard for that entry into the future.

The program envisioned for the senior high school is an attempt to move the school from its traditional emphasis on passive involvement with the past to an aggressive excitement and active encounter with the future. This latter involvement was identified by C. P. Snow as a matter of greatest need for man, when he stated:

> The world's greatest need is 'an appetite for the future'... All healthy societies are ready to sacrifice the existential moment for their children's future and for children after those. The sense of the future is behind all good policies. Unless we have it, we can give nothing either wise or decent to the world. (5,p.43)

The appetite for the future stands out as a principle feature of the program that I would like to discuss with you in the remaining time.

The development of the senior high school program as projected in this discussion grew out of a concentrated study over a period of several years. The final phase of the study involved a number of outstanding graduate students who organized as a data-collection and data-refining team.

The major topics studied by this group were the following:

(1) The Nature of the Society in the Next 30 Years

(2) Curriculum Trends at the Secondary School Level
(3) The Nature of the Senior-High School Student
(4) Socio-Psychological Theories Governing Man's Behavior.

The complete sequence of events or procedures that led up to the projected program is presented in the schematics appearing on the following pages.

This intensive study and refinement process produced a significant quantity of data and a greatly expanded bibliography that extended into new and challenging dimensions of society -- today and tomorrow.

Underlying concepts basic to the direction of the program are as follows: (1) The students of today will live their lives in the future, thus the emphasis was on a program aimed at education for the future.

The concept of a future-oriented program in the senior high school is reinforced by an awareness of the acceleration of technological innovation. The time between invention and widespread application of that invention may have taken a hundred years in past societies. As an example, it took 112 years for photography (1727-1839). Today the time lag is greatly reduced for many significant and far-reaching innovations. It took just five years (1948-1953) from invention to widespread application for the transistor. The integrated circuit took only three years (1958-1961).

The significance of this acceleration of technological innovation is the greatly reduced lead time permitted society to adjust. Herein lies the cause of numerous social and emotional problems associated with a dynamic age such as ours. This increased acceleration of technological innovation also has a profound effect on the phenomenon of obsolescence, which appears as a common issue in contemporary commentary.

Education and the products of education in a dynamic age may actually be casualties due to the rate of technological turnover or innovation. That education which focuses on today (in this or subsequent decades) is actually preparing people for yesterday.

The future of communications, transportation, power generation, etc., is already on the drawing boards, or in pilot experimental models. To develop in people the ability to anticipate, to adjust, and to make effective decisions in a dynamic and accelerating society cannot be left to an educational system that dwells on the past.

(2) Technology will play an increasing role in the solution of major social problems. The problems associated with a world population that will double in the next thirty years will in part center around greatly expanded and improved systems for meeting society's needs for water, air, transportation, communication, power generation, housing and other elements of a compatible environment.

(3) A review of the literature and an analysis of the data in our earlier studies supported the following listing as major social, environmental and operational problems that face man in the immediate and subsequent future.

(a) Pollution (air, water, noise, etc.)
(b) Conservation (natural resources)
(c) Housing and Urban Development
(d) Power Generation
(e) Water Supply
(f) Production Processes
(g) Transportation
(h) Communications
(i) Resource Utilization
(j) Trash, Waste, Junk Disposal

Each of these pressing problems has been identified as a significant area for study in the senior high school industrial arts laboratory.

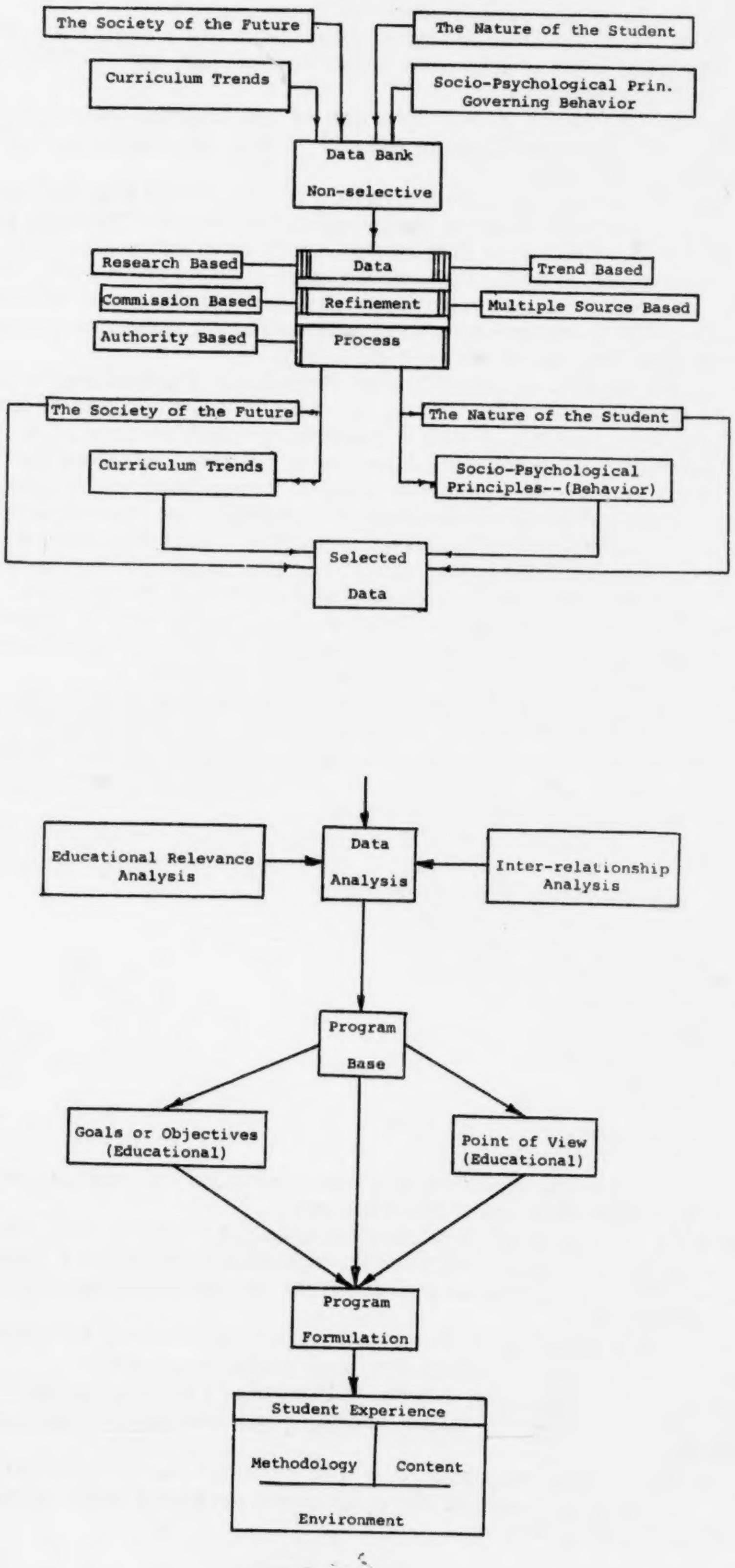
The problems of food production, medicine, social ordering, etc., were not included because of an attempt to remain within some semblance of boundaries associated with the present program of industrial arts, as well as within the functional capability of the laboratory and its environment.

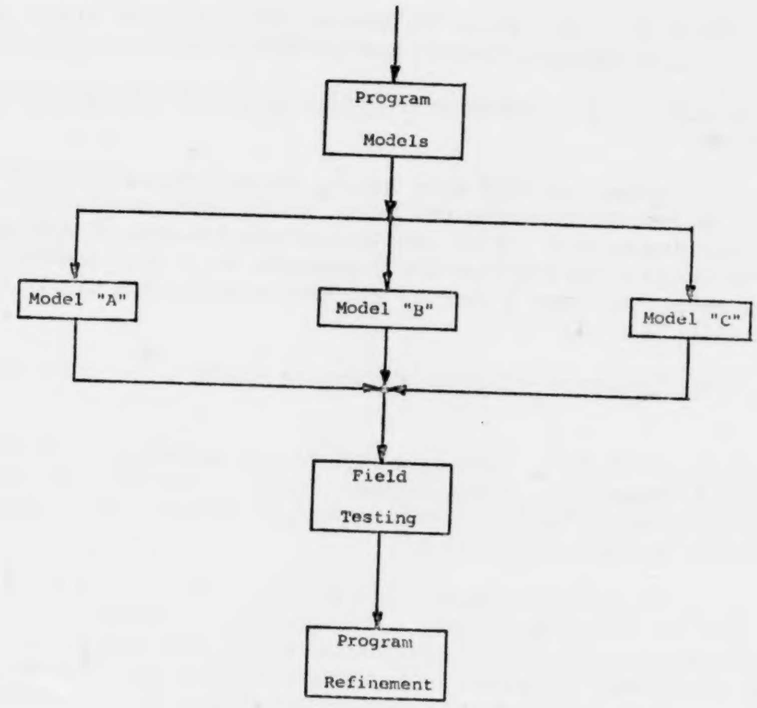
The focus in this program is on technology and its potential for assisting in the development of people capable of dealing with such major problems.

Specifically, I am suggesting a form of industrial arts that explores the application of technology in the solution of major social, environmental and operational problems that face mankind.

The significance of this emphasis on what technology can do for mankind in the solution of major social, environmental and operational problems takes on many dimensions as valid educational enterprise.

Program Development Model
for the
Senior High School
Industrial Arts


The Society of the Future
The Nature of the Student
Curriculum Trends
Socio-Psychological Prin. Governing Behavior
Data Bank
Non-selective
Research Based
Data
Trend Based
Commission Based
Refinement
Multiple Source Based
Authority Based
Process
The Society of the Future
The Nature of the Student
Curriculum Trends
Socio-Psychological Principles--(Behavior)
Selected Data
Educational Relevance Analysis
Data Analysis
Inter-relationship Analysis
Program Base
Goals or Objectives (Educational)
Point of View (Educational)
Program Formulation
Student Experience
Methodology
Content
Environment


Program Models
Model "A"
Model "B"
Model "C"
Field Testing
Program Refinement

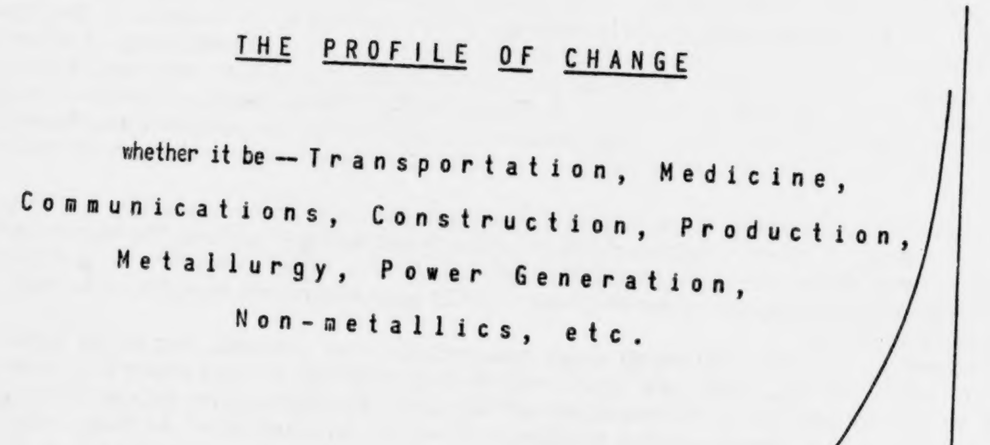

THE PROFILE OF CHANGE
whether it be — Transportation, Medicine, Communications, Construction, Production, Metallurgy, Power Generation, Non-metallics, etc.
AD
1200
1300
1400
1500
1600
1700
1800
1900

Figure 1

George S. Counts has stated that, "We must strive in all haste to rear a generation capable of living with and directing towards humane ends all the resources of science and technology". (4, p.9)

Aaron W. Warner, in his introduction to Technology and Social Change, has made the following statement:

> A source of great authority over nature, the modern scientific-technology promises to be both the hope of man's future and the instrument of his enslavement and his destruction. If we are to avoid the disasters it lays open to us and take advantage of the opportunities it presents, we... must understand what modern technology is, what it means, and what must be done with it, if it is to serve man well. (15, p.1)

Don Fabun in his Dynamics of Change discusses a similar point in the following comment:

> The forces of change,... are amenable to our guidance. If we seem to be hurried into the future by a runaway engine, it may be that the main reason it is running away is that we have not bothered yet to learn how it works, nor steer it in the direction we want it to go. (6, p.5)

The need for understanding technology and what it can do for mankind is not unique to any group within the school or society. It is a universal requirement in a democracy where decision making at all levels is basically tied to the sophistication of the electorate. Such education transcends the criterion of general education and assumes the position of imperative education if man is to attain new heights of humane achievement rather than self-destruction and enslavement.

The need for understanding technology in a democracy is discussed under the topic of "Technological Ignorance" in the text of Dynamics of Change, as follows:

> The contention that persons ignorant of technology can function in a democracy to any effect when the society is a technological one is dubious. Understanding is not a prerequisite of control; it is control. (6, p.30)

The above statement leads directly into one of the major objectives of the new program for the senior high school. This goal is to provide a form of education that will attempt to bridge the gap between the technological elite and the great masses of the population who must live with and make decisions relative to the uses of technology in shaping man's future. The constantly widening gap between these two groups has been a matter of sincere concern by such people as C. P. Snow, Barbara Ward and those involved in the Commission on the Year 2000. The issue is largely one of who will maintain control, coupled with the capability of the populace to make decisions within its sphere of understanding.

Emphasis on the study of technology in the past has been on its capability to produce more and better, to move man from the cave to the skyscraper, to deliver the human from the hoe to the supermarket, to extend man's life and reduce infant mortality, to move man and messages at undreamed-of speeds, and to build huge automated complexes as well as our sprawling cities.

Technology has not only made these accomplishments possible, but in the process of such achievements, man has also seen fit to pollute his air and water to a point of threat to human existence. He has used and discarded the fruits of his productivity with such facility as to create severe problems of waste, junk and trash disposal. He has created and sold air-conditioners for which there is insufficient electricity to use them when they are needed. He has severely over-taxed the traditional water resources to a point of imposed legal regulations and critical shortages. His ingenious medical developments have contributed to a population explosion that is rapidly reaching crisis proportions. These are but a few of the problems that have followed in man's wake as he has sought the good and abundant life as well as the means to expand his horizons.

The problems mankind faces are fully within his grasp to solve. The magnificent accomplishments of NASA in its lunar expeditions are ample evidence of what a nation can do when it comes to a decision of what it wants to do, how it wants to use its resources, and the extent to which society will employ its technological "know how". This same "can do" thinking and resolve could meet the challenges in the problem areas identified, as well as in many others.

The technology to deal with many of these problems already exists.

"Dr. Lee A. DuBridge, president of the California Institute of Technology, has said that from a purely technical standpoint we know enough to --

(1) Produce enough food to feed every mouth on earth -- and to do this even though the population may double or triple.

(2) Make fresh water out of sea water and then irrigate all of the world's arid regions.

(3) Produce enough energy from uranium to light and heat our homes and offices, electrify our railroads, and run all of our factories and mills.

(4) Build houses, buildings, and indeed whole cities, which are essentially waterproof, heatproof, cold proof and storm proof." (2, p.13)

Dr. Alvin W. Weinberg, director of the Oak Ridge National Laboratories, discusses a series of "technological fixes" in an article entitled "Can Technology Replace 'Social Engineering'?" (17, p.56,57)

Two such fixes in the past, according to Dr. Weinberg, have dealt with the problems of war and widespread poverty. A third fix proposed for the future deals with the solution of the water shortage problem through the use of nuclear desalination plants.

A further examination of the potential for the production of water as well as of electricity is found in a statement by Fred Warshofsky in his text The 21st Century -- The New Age of Exploration.

> At today's prices, a kilowatt-hour of nuclear energy costs approximately one-half a cent. By the year 2000 nuclear power may reduce the cost to about a tenth of a cent a kilowatt-hour. That would make the cost of producing a thousand gallons of fresh water less than half a cent. Today, industrial fresh water sells for about twenty cents per thousand gallons, including delivery. (16, p.50)

The essential ingredient to the solution of many of the previously-mentioned problems facing mankind in the years ahead is education. The future citizen will depend more and on the application of technology to deal with these and related problems.

Technological ignorance on the part of a vast proportion of the populace may lead to self-destruction, ineffectiveness, or decisions by a technocratic elite. A recent article in the Science and Technology journal, entitled "Managing Technology", discussed the issue of planning for change by "technical men".

> Technical men are likely to be increasingly concerned about the future in their own ways. As we move into what is being called the 'postindustrial society', science and technology are bound to be more and more at the center of change and more concerned with the planning of change. (19, p.73)

This statement leads me to a slight by-pass in the general discussion of this topic to interject a point or two in order that I may clarify a personal position. That is, I do not labor under any delusions that technology alone is the answer to the many problems mankind faces.

Although this discussion deals with the application of technology in the solution of major problems facing mankind in the future, I am fully aware that this proposition is only one side of the coin.

The issue is whether man can continue to exist with other men, or whether mankind can endure in a world of excesses growing out of an uncontrolled materialistic appetite symbolized by waste, exploitation and destruction at any cost. This is a facet of the problem that I, too, am concerned about. It is a major component of the other side of the coin.

The problems of pollution, conservation, housing, power generation, transportation, communication, resource utilization and productivity grow out of the aspirations, the ideals, the sensitivities or insensitivities of mankind. The solution to these problems does not lie alone in the realm of technology, but in the realm of man's concern for man, and in a sense of direction that takes issue with the notion that the planet earth is an inexhaustible source of natural beauty and richness to be converted by senseless economic values into a sprawling junkyard.

Dr. Daniel Bell, writing on the year 2000, stated the issue very simply when he wrote, "The problem of the future consists in defining one's priorities and making the necessary commitment...." (1, p.8)

Erich Fromm elaborated on this point in his text, The Revolution of Hope Toward A Humanized Technology, in the following quotation:

> ...man, not technique, must become the ultimate source of values; optimal development and not maximal production the criterion for all planning. (8, p.100)

The issue appears to be one of order as well as priority. That is to say, there must be a broad and searching analysis made of the directions man wants to travel, and then his ingenious technology must be applied toward the established goal.

Bertrand de Jouvenel was quoted on this point in a recent text by John McHale, entitled The Future of the Future:

> Finding out what we want should become a major object of attention... there is a vast difference between letting changes occur under the impact of technological advances and choosing the changes we want to bring about by our technological means. (10, p.8)

The citizenry must be brought to a level of concern as well as understanding regarding the course and direction in which the society is moving. The pressures of advertising, production and consumption leave us caught up in a system which should force the intelligent citizen to inquire about the direction and meaning of such a society.

Thomas Tanner, in the March, 1970, issue of Phi Delta Kappan, discussed the matter of tomorrow's technology and today's license in a series of statements consistent with the point I am making:

> A common excuse for the exercise of greed, irresponsibility and shortsightedness is that tomorrow's technology can clean up the resultant mess. ...Business equates growth with progress, and the depletion of natural resources is euphemistically referred to as development of natural resources.
>
> ...technology is applied to these problems (pollution, depletion of natural resources, famine, degradation of environment) while population growth and economic irresponsibility are accepted or even lauded. Smog devices, desalination plants, floating cities, and high-yield food production methods lull the public into a blind faith in technology.... (13, p.354)

The issue is clear that the total school and all other agencies involved in the development of our national goals must get on with the business of dealing more effectively with the elements of social, economic and environmental awareness.

The task of providing an environment compatible with the needs of future man cannot be accomplished by any single group concern such as technology, sociology, physiology, etc. It will require first of all a sense of direction and then a sense of urgency and judgment in using the skills and knowledge needed to accomplish the task. Again, I must indicate that my presentation of this other side of the coin was simply to illustrate that I do not have a total preoccupation with technology and a lack of sensitivity to the other elements associated with the problem.

It became obvious that the senior high school program should be broad-based and relevant to the total spectrum of students as opposed to present offerings that favor limited skill and technical development. It was projected that the program would assume the dimension of inclusiveness that would not be hemmed in by occupational aspiration or curricular involvement. The problems as identified belong to no special group; they are everybody's problems.

The objective was to arrive at a content that would be integrally tied with major societal problems to such an extent that the school would actually move out into that mainstream of life itself. It was to be an educational program that explored the solutions to man's pressing problems, present and future. The student would in this way find himself a part of the on-going scene. This principle of contemporary involvement is supported in a statement by Arthur W. Foshay in an article appearing in the March, 1970, issue of Phi Delta Kappan:

> Our secondary school students... want to see themselves as participants in the world they live in, not as apprentices for it. They want the world to be in the school and the school in the world. (7, p.352)

It is here where the issue of "relevance" comes into play. The population is a fast-maturing high school student body with a sophistication that far exceeds that of its predecessors. Today's student is greatly concerned about where society is going and what lies ahead. The communications media of television, radio, newspapers and paperbacks have continuously bombarded the student with endless commentary on each of the problem areas identified for study. The central concerns of this program are in fact central concerns of society itself. This in itself is a profound difference over the content of present and past programs. It also is important to note that other educators have expressed similar interest in dealing with contemporary social and environmental problems.

Dr. John Goodlad, in an article entitled "The Educational Program to 1980 and Beyond", has urged a look ahead in curriculum development:

> ...Get into the curriculum the problems likely to be facing young adults in 1980. These persons currently are in the primary years of schooling. If we were to begin now, we could plan for them a junior high school curriculum organized around problems of population, poverty, pollution and many more. (9, p.57)

James Swan has written an article entitled "The Challenge of Environmental Education", in which he states --

> Creating a concern for environmental quality can, and I feel should, be a function of our schools. I should like to suggest that this could be done through a comprehensive 'environmental education' program.
>
> ...environmental education is concerned with developing attitudes of concern for environmental quality.
>
> Environmental education...is concerned with involving people in environmental problem solving. (12, pp. 26-68)

Another objective of the high school program is to place the student and the industrial arts activity out in the mainstream of life. This will involve a whole new orientation on the part of the teacher as well as of the school itself.

Ralph Tyler, in a discussion of the "Curriculum for a Troubled Society", has stated that --

> One factor standing in the way of developing an effective curriculum and educational program is the tradition that the high school should be an adolescent island outside the major currents of adult life. (14, p.35)

The involvement of the student in the examination of such problems, the study of alternate solutions, and the identification of future problems could have profound effects upon the future. I will venture to mention a few as follows:

(1) The voting public (decision makers) of the future would have a sensitivity to the kind, nature and extent of such problems facing mankind.

(2) He would have some understanding of and sensitivity to the nature of solutions and the alternatives related to the problem.

(3) The strength of his adult participation in dealing with such problems may be greatly enhanced by his earlier involvement in real and direct experiences related to them.

(4) The student through appropriate kinds and levels of involvement could begin to feel he is a part of the system and he does have a role to play.

(5) The student's communication with his or her parents and other adults on the concerns and activities of the program would have the potential for even wider levels of involvement.

A number of guidelines were established for the development of the senior high school proposal for industrial arts. These grew out of the extended and in-depth study of the nature of the student, curriculum trends, socio-psychological theories affecting behavior, and the nature of the society of the future.

(1) The development of each individual was of prime concern. That is, the concerns, interests, aptitudes, aspirations, abilities and motivations of each individual must remain the central focus.

(2) The program has centered on a process orientation. In this respect emphasis

has been placed on such processes as problem solving, inquiring, experimenting, evaluating, constructing, planning, analyzing and cooperating with others.

(3) A high level of student involvement has been structured into the learning activities of the program.

(4) The physical setting of the program extends out into every sector of the school, the community and the nation as valid sources for information and assistance.

(5) The traditional craft textbooks have given way to contemporary newspapers, magazines, scientific journals, industrial house organs, government publications, commission reports and research findings.

(6) A broad range of instructional media is applicable and includes audio and video tapes, movies, slides, models, exhibits, graphics, collections and specimens.

(7) The role of the teacher may be described as a "manager of education". It is his job to facilitate, encourage, stimulate, evaluate and advise, and to provide an optimum environment for learning.

(8) Although the emphasis is primarily on the development of the individual, stress has been given to the structuring of group process involvement and learning experiences in order to provide the setting for interaction, role-playing, self-direction, peer-culture identification, cooperation, challenge, assuming responsibility and democratic participation.

No attempt has been made at an identification of problem areas by grade levels. This is a matter for individual school or teacher planning and decision making. It is a flexible operating structure built around a series of problems. The opportunities for interdisciplinary involvement with the many other areas of the school are numerous.

Of special importance is the possibility of a series of strong cooperative activities between the high school program and the surrounding community, which may have any number of live projects associated with the several problems as previously listed. The setting of the school might appropriately find itself in the chambers of the water purification plant, the local pollution control office, a meeting of the housing and urban development committee, a planning meeting of a dust control project in a local industry, as well as a field experiment on pollution of a stream, bay or river.

A good start in planning for such a program might be to explore the local area for active projects or needed areas of concern and action. It might be well to determine the range of resources in the community that could be called upon for support and assistance in the instructional elements that would get beyond the technical capability of the teacher.

This senior high school program has within it the possibility for real and meaningful experience. It would put industrial arts out into the mainstream, out where the real answers and the dynamics of society provide an educational input unequalled by other areas of the school.

The work in the laboratory would be an integral part of the total experience. Planning, constructing, testing, evaluating – all take on meaning as the students use tools, materials, ideas and ingenuity to explore the application of technology in the solution of major problems facing man in the future.

The illustration following is a graphic illustration of the several elements that comprise the program:

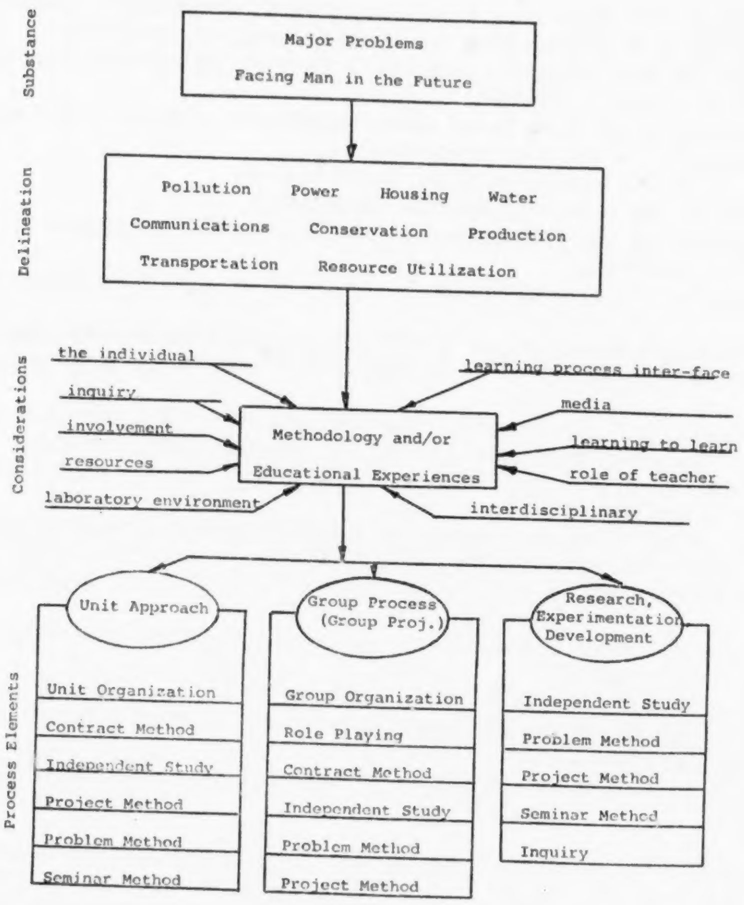
(1) Substance -- This is the essence of the proposal, i.e., major problems facing man in the future.

(2) Delineation -- This is the identification of selected problem areas considered suitable for study in the industrial arts facility and which would be somewhat related to the technology usually associated with the area. These include: pollution, power, housing, communications, conservation, production, resource utilization, transportation and disposal.

(3) Considerations -- This is a listing of the concerns that helped shape the design of the educational experiences, the strategies and the methodologies. These included an emphasis on the individual, inquiry as a process, involvement, the nature of resources, laboratory environment, use of media, the implementation of "learning to learn" procedures, the role of the teacher, an interdisciplinary approach, and a learning process interface that brings together a variety of supportive and complementing processes.

(4) Process Elements -- These are the major instructional organizational strategies that were considered to be most appropriate for the study of as well as an encounter with selected major problems facing man in the future.

Each of these processes, i.e., the unit approach, the group process, and the research,


Substance
Major Problems
Facing Man in the Future
Delineation
Pollution
Power
Housing
Water
Communications
Conservation
Production
Transportation
Resource Utilization
Considerations
the individual
inquiry
involvement
resources
laboratory environment
learning process inter-face
media
learning to learn
role of teacher
interdisciplinary
Methodology and/or
Educational Experiences
Unit Approach
Group Process
(Group Proj.)
Research,
Experimentation
Development
Process Elements
Unit Organization
Contract Method
Independent Study
Project Method
Problem Method
Seminar Method
Group Organization
Role Playing
Contract Method
Independent Study
Problem Method
Project Method
Independent Study
Problem Method
Project Method
Seminar Method
Inquiry

experimentation and development procedure, has been tried out in higher education classes, high school classes and at the junior high school level, using the major problems approach. (A more complete explanation of the use and procedures involved in each of these three organizational strategies will be presented in the following paper.)

Finally, by way of summary and review, I would like to present the issue as I see it; a proposal that addresses itself to the issue; a series of hypotheses or speculations about the program; and lastly a listing of anticipated outcomes.

Issue: The need to develop a program for industrial arts at the senior high school level that would have a high degree of relevance for and acceptance by the students, the school and society.

Proposal: That the industrial arts profession operating at the senior high school level move toward a program which explores the application of technology in the solution of major social, environmental and operational problems that face mankind.

Hypotheses:

(1) It is possible to develop a society-oriented problems approach that could be successfully carried out in the environment (immediate and expanded) of the industrial arts laboratory.

(2) The development of such a program would attract students from all levels and curricula to a much greater extent than the present programs.

(3) The acceptance and recognition of the program by the school and community would be a great deal improved over existing activities.

(4) A broader spectrum of students would find interest, a personal association, and a higher degree of relevance to their own lives in this program.

(5) It would appeal to students in keeping with their growing concern for the kind of a society in which they are growing up.

(6) The potential for developing broad and diverse manipulative, mental and social skills would be equal to or greater than the more conventional programs.

(7) The industrial arts teacher in general is the most appropriate of the professional educators to deal with such a program.

(8) The program would have broad interdisciplinary potential with unusual opportunities for the interface of learning processes.

Outcomes: It is projected that the program would lead to:

(1) a concern for the trend and direction of society,
(2) an awareness of the alternatives available to man in his search for solutions to certain major problems,
(3) the student's active involvement in exploring the solutions to selected societal problems,
(4) an awareness of the accelerating technology and a readiness for changes,
(5) a bridging of the gap between the overwhelming majority of the populace and the technical elite,
(6) an awareness of occupational opportunities associated with the application of technology to the solution of selected major problems facing mankind,
(7) an opportunity to use the tools and materials of industry in a new and dynamic encounter with society,
(8) an opportunity to test one's ingenuity, ability and potential in meaningful activities directed towards the solution of pressing problems,
(9) an awareness of one's own capabilities as a member of a team, group or as an individual,
(10) an increased ability to use the expanded resources of the community in the process of "learning to learn".

There are two major thrusts in this program that I feel are important. First, there is the persistent interest in and insistence on the goal that the student is the prime element for development in education.

One of the finest expressions of this point recently appeared in the Chemical and Engineering News:

> It is impossible for the average boy to grow up and use his remarkable capacities that are in every boy, unless the world is for him and makes sense. And a society makes sense when it understands that its chief wealth is these capacities. (18, p.4A)

Secondly, it is a thrust of the school out into society in a dimension that has few parallels. The program is an active involvement with live societal problems that demand high priorities rather than the usual preoccupation with meaningless educational minuets and the pursuit of activities related to the past.

> The challenge is to move out into the mainstream of education, to move out into the deep and wide channels of involvement with the total school and society.
>
> --out into the waters of life itself where the depth of issue will permit the maneuverability to cope with the range of human interests, abilities and capacities....

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The basis for a senior high school program in industrial arts

Karl E. Gettle

The last half of this program consists of presenting the why, how and where of the senior high school program which Dr. Maley has just described to you.

Let me begin by asking you to solve a very simple mathematics problem. What is the answer to the following?

$$\begin{array}{r}4\\ \underline{2}\end{array}$$

Some of you may give the answer as six - since you added the two numbers; while others may have given answers of eight or two. Each of you may be right, depending on the method you used. However, the procedure which you used to arrive at your answer had to be by the "hit or miss" approach, since no sign was given as to the procedure to be followed. What most of you failed to do was to ask, "What is the problem?" This is the same question which I feel most of us fail to ask about industrial arts – that is, what is the problem?

I would like to describe the problem which we at the University of Maryland took into account when we formulated our senior high school program for industrial arts.

The first part of the problem which we looked at was, what is industrial arts? The following definition, which basically comes from Wilbur (5, 2), has been accepted by most of us in the field:

> Industrial arts as a curriculum area is defined as those phases of general education which deal with technology – its evolution, utilization and significance, — with industry – its organization, materials, occupations, processes and products, — and with the problems and benefits resulting from the technological and industrial nature of society.

This description tells us that industrial arts is: (1) General education, and by that, I take it to mean education for all boys and girls regardless of their ability or any other factor one may wish to select. (Let me be quick to point out that this does not imply the same experiences for all.); (2) a study of technology in terms of its evolution, utilization and significance; (3) a study of industry in terms of its organization, materials, occupations, processes and products; (4) a study of the problems and benefits resulting from the technological and industrial nature of society. These last three points gave us quite clear directions to the content and method of industrial arts. Our program has taken all of these into account, for it was our feeling that any program for industrial arts must contain the abovementioned elements.

The second part of our problem is, what do the experts in curriculum say we should be doing in education? Dr. Ole Sand (3, 9) has given us some direction when he said,

> It is possible that in the next decade we should consider moving in the following directions:

From	To
(1) The group	The individual
(2) Memory	Inquiry
(3) Stimulus-response psychology	Organismic psychology
(4) Spiritless climate	Zest for learning
. . . . . .	. . . . . .
(6) Repetition	Spiral reinforcement
. . . . . .	. . . . . .
(14) Teaching as telling	Teaching as a creative art with a scientific base

The emphasis of the school, as pointed out by Sand, must go from group instruction to individual instruction. Therefore, we can no longer view our classes as being five rows of five students each, where all the students are subjected to the same experiences. Rather, we must look at our students as individuals, each with a difference, and then treat them as such.

Sand also points out that the content which we offer our students must not be based on memory, but on inquiry. Louis Rubin, (2, 154) in his discussion of "Life Skills in School and Society", supported this concept when he said,

> The behavioral objectives-to use the current term-should include not only the acquisition of facts, principles and concepts, but the ability to reason as well. How the child learns this becomes as important as what he learns . . . the curriculum of the future may be characterized by children who learn not only to read, write and count, but also to infer, predict, analyze and verify.

This type of education has no room for a stimulus-response psychology, repetition and a spiritless climate, but rather provides for use an organism psychology in the classroom where there is a zest for learning provided through creative teaching with a scientific base.

Another part of the problem is, what are the needs of the students? Developmental tasks provide us with perhaps the best guide to student needs. Havighurst (1, 39) has listed the following developmental tasks for senior high school students:

ADOLESCENCE

(1) Achieving new and more mature relation with age-mates of both sexes.
(2) Achieving a masculine or feminine social role.
(3) Accepting one's physique and using the body effectively.
(4) Achieving assurance of economic independence.
(5) Achieving emotional independence of parents and other adults.
(6) Selecting and preparing for an occupation.
(7) Preparing for marriage and family life.
(8) Developing intellectual skills and concepts necessary for civic competence.
(9) Desiring and achieving socially responsible behavior.
(10) Acquiring a set of values and an ethical system as a guide to behavior.

The provision for the encounter and the evolvement of these student needs can and must be incorporated into the curriculum if we are truly interested in the development of people.

The fourth part of the problem is to develop individuals who will be useful to society and who will be capable of performing the tasks that will be required of them. A survey of the literature has produced the following items which society will expect of a person:

(1) Social responsibility
(2) Economic sufficiency
(3) Self renewal
(4) Leadership
(5) Followership
(6) Problem-solving
(7) Adaptability
(8) Social, economic and political sophistication

A check of this list reveals that "telling" will not accomplish these goals, but rather they must be inherent in the curriculum so that students can have experiences in these areas and thus gain first-hand understanding of their meaning.

The last part which I would like to identify concerns what employers say they want from our graduates. The Tennessee State Employment Bureau (4, 9) lists the following characteristics which they found employers want in their employees: ability, dependability, initiative, reliability, good attendance, efficiency, loyalty, cheerfulness, helpfulness, unselfishness and perseverance. It may be revealing to some of us the items which appear on this list. It may be that industry is trying to tell us something. These traits, like the ones listed as society expectations, require development, and, therefore, provision must be provided for their development. The problem then is: (1) what is industrial arts; (2) what direction should curricula take; (3) what are the needs of the students; (4) what are the requirements of society; and (5) what are the expectations of employers.

We at the University of Maryland took all of these items into consideration when we developed our senior high school program. It is our sincere feeling that in order to have a program of relevance in terms of content and methodology, all of these factors had to be incorporated in order to solve our problem. However, our problem was not completely solved, for we had to have a means of implementing the program. Our answer to this problem was to use the unit, group project, and research and experimentation methods of teaching. These methods were selected because they provided the opportunities for the coverage of the content, and for the sound educational experiences which allow for the development of people in a dynamic age.

At last we feel that we have asked ourselves what the problem is. When all the evidence was in, we found that our original premise – to be developers of people rather than inspectors of projects – was still valid. While industry and technology and all their ramifications are the subject matter of industrial arts, the development of people must be our chief concern. There can be no greater reason for the existence of our schools.

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Developing individualized instructional systems for industrial education

Nevin R. Frantz, Jr.

Industrial educators have been espousing for many years that instruction in their area of the curriculum provides for individual differences and individualized instructional opportunities. Perhaps this has been true, in a semistructured manner, with the utilization of student-selected projects and individual attention to pupils working within a laboratory.

Efforts have been made recently to prepare polysensory learning systems for industrial education, using a multimedia approach (Allen and others, 1968; Nish, 1967; Hill, 1967; Sergeant, 1968). The great need, however, is for a total individualized instructional system designed to determine where students are from the outset of instruction as well as student utilization of various instructional modes and evaluation of student achievement based upon performance objectives.

Rationale for individualized instruction. Traditionally, teachers have been assigned a group of twenty or thirty students and have attempted to provide instruction for this group at the same time, place and rate of speed. This approach has placed demands on a teacher that result in instructional strategies which may optimize learning for "average" students, but do not provide optimums for the above- or below-average pupil. Many of the instructional strategies selected by a teacher force him to become the "fountainhead" of knowledge which is to be transmitted to students through a verbal lecture or demonstration. This approach depends upon efficient group organization and often impedes individual progression and achievement.

Learning might be accomplished more efficiently and effectively if instructional modes were available that capitalized on the particular strengths brought by students to the learning situation. Students would be placed in the position of utilizing instructional modes which provided personal optimums for achievement rather than being forced into a single instructional mode which might not be most appropriate for them.

Several studies imply that differential variables may be identified and instructional modes or treatments designed to interact individually with student differences in the attainment of an educational objective. (Osburn and Melton, 1963; Hills, 1957; Behr, 1967) Other studies indicate an absence of treatment interaction with specific aptitudes. (Cronbach and Snow, 1969; Hamilton, 1968; Behr, 1967) Although conflicting evidence exists at the present time, it is an important area of investigation which needs further clarification.

A need exists to develop models and strategies for individualized instructional systems that are applicable across the breadth of industrial education at the elementary, secondary and post-secondary levels. Industrial arts instructors at the junior high, or middle school, level encounter students at various points on a learning curve, such as mathematical and measurement skills needed for successful performance in an instructional program. Senior high school teachers obtain students with backgrounds ranging from no previous instruction in a content area, to an in-depth study of the area. Junior college and university instructors encounter similar diversity of student knowledge and experience in any given area of industrial and technical education.

The composition and organization of industrial education courses also create instructional problems. Students of divergent and differential abilities progress or rotate through various instructional areas. On many occasions students are engaged in the solution of problems unique to their individual endeavors and learning tasks. The demands placed on a single instructor to provide individual attention to students in accomplishing educational goals and objectives often becomes insurmountable. Efforts to cope with these problems in a conventional manner usually result in inefficient use of instructional time and a diffusion of teacher attention to student requirements.

Individualized instruction may be useful in solving instructional problems at each of these levels and could be utilized with students: (1) learning the subject-matter of an entire course, (2) as a self-teaching method for remedial work in a segment of a program, and (3) for voluntary, in-depth study in a content area of interest.

The purpose of this paper is to suggest a general procedure for developing individualized instructional systems.

Procedures in developing an individualized instructional system. The development of an individualized approach to instruction is based upon several components which serve to integrate and structure the learning environment for each individual student. The following components should be considered in the development of any individualized instructional system:

(1) Selecting the instructional content for adoption to an individualized instructional system.

(2) Specifying course objectives in behavioral terms that describe what the learner must be able to do, the conditions under which the student operates, and the minimum standard of achievement.

(3) Developing learning sequences that describe the learning paths students can travel in order to attain each course objective.

(4) Identifying and selecting a variety of instructional media (programmed instruction, video-tape recordings, closed loop films, etc.) suitable for an individualized instructional approach.

(5) Developing instructional materials as required to supplement those materials readily available.

(6) Preparing evaluative instruments and procedures that diagnose and monitor individual progress through the learning sequences.

The initial consideration in developing an individualized instructional system is the selection of a course, or course segment, for adaptation to the approach, as shown in Figure 1. One may not be in a position to attempt the development of an individualized instructional system for an entire course or program. An expedient point of departure is the selection of a block of instruction or single objective within the total course.

The next procedure in the process of developing individualized instruction is the specification of learning outcomes, or instructional objectives, in terms of pupil performances. The preparation of statements which specifically describe pupil behavior or performance has been discussed by a number of writers (Mager, 1962; Esbensen, 1967). The exact format and style are immaterial to the problem of objective specification; however, it is important to delineate with precision and clarity what is to be learned and how the learner will exhibit the acquired knowledge, skill or attitude.

After carefully specifying learning outcomes in behavioral terms, a learning sequence for each objective is established, through which the learner will progress to the attainment of the terminal objective. One way to develop the learning sequence is to ask the question, "What competency prerequisite must the student be able to perform in order successfully to attain the next step in the sequence?" (Gagné, 1965) The result of this self-interrogation is the establishment of a hierarchy which orders the steps of sub-objectives in the learning sequence as shown in Figure 3. The hierarchical order of the learning sequence does not dictate the order through which every learner must travel, since some pupils may have competencies in one or more of the sub-objectives and will therefore be able to by-pass various steps in the sequence. The sequence itself merely provides a structure for determining a pupil's present status and plotting his own learning sequence.

The fourth step in the process of developing individualized instructional programs is the identification or development of instructional materials and methods for learning each sub-objective or step in the learning sequence. Many of the required instructional materials are commercially available and range from textbooks to closed-loop films. Other materials may require self-development on the part of a teacher. In implementing the program, it is important to identify or develop a variety of materials in order to provide students with a range of choices for the attainment of each objective. Some students may attain proficiency with verbal materials alone, while others may require visual and manipulative devices.

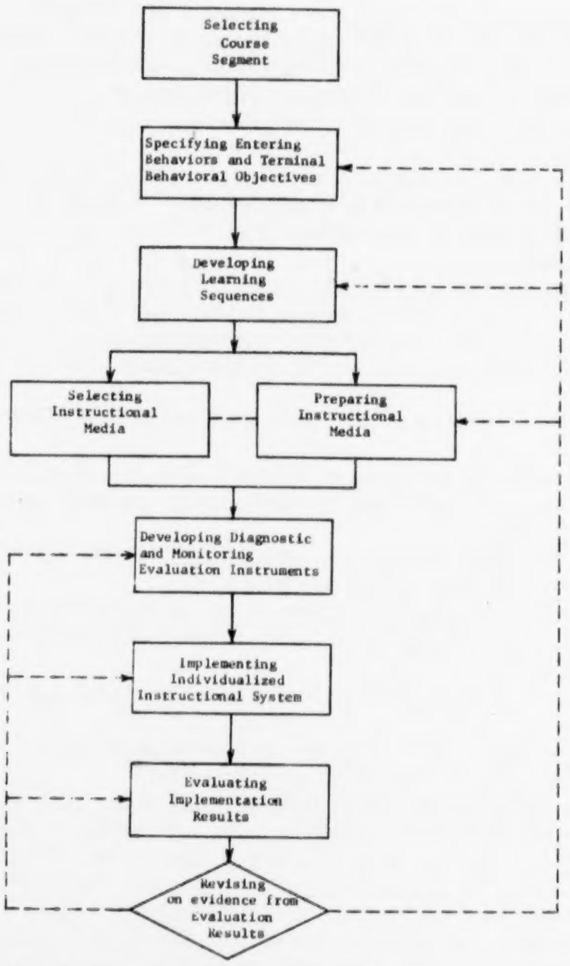
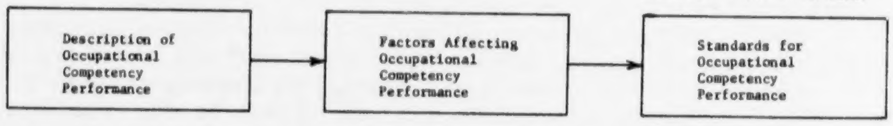

Selecting Course Segment
Specifying Entering Behaviors and Terminal Behavioral Objectives
Developing Learning Sequences
Selecting Instructional Media
Preparing Instructional Media
Developing Diagnostic and Monitoring Evaluation Instruments
Implementing Individualized Instructional System
Evaluating Implementation Results
Revising on evidence from Evaluation Results

Figure 1. Developing an Individualized Instructional System.


Description of Occupational Competency Performance
Factors Affecting Occupational Competency Performance
Standards for Occupational Competency Performance

Making a full page, centered paste-up

This part of the statement began with an action verb and described the results of the action.

Using line copy and a waxing machine.

This part of the statement described factors affecting performance of the competency. Factors considered were:

(1) tools, materials, and equipment used;

(2) environmental conditions;

(3) reasons for performing the competency; and

(4) order of performing the competency.

To obtain a finished flat with all lines of copy fastened securely and aligned to an accuracy of 1/16 of an inch.

This part of the statement was used when appropriate to describe the standard of performance that must be achieved. Standards considered were:

(1) the degree of accuracy required;

(2) the speed required for completion.

(3) the final position or location of objects.

Figure 2. Format for Preparing Task Statements in Behavioral Terms.

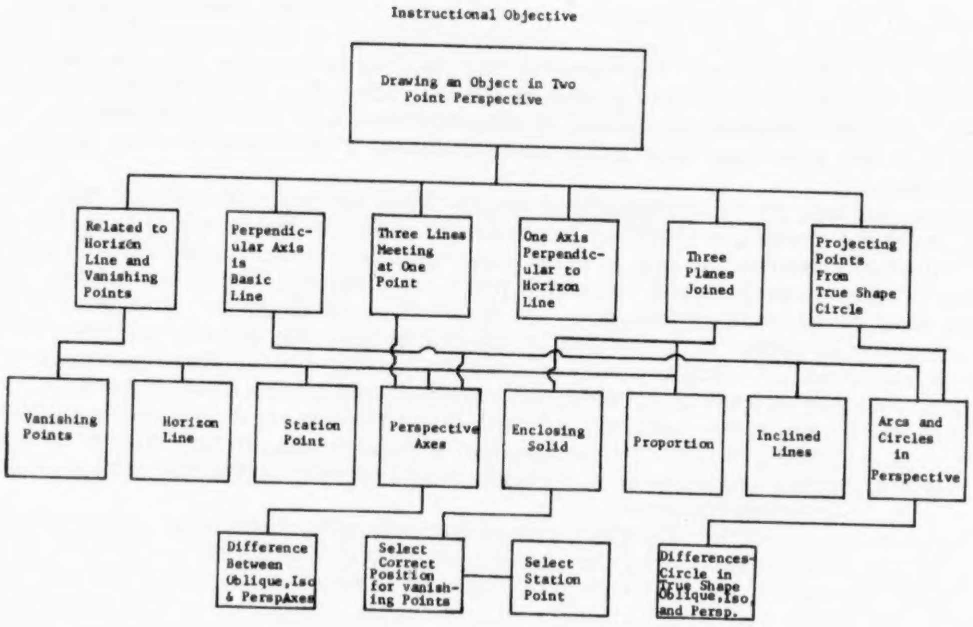

Instructional Objective
Drawing an Object in Two Point Perspective
Related to Horizon Line and Vanishing Points
Perpendicular Axis is Basic Line
Three Lines Meeting at One Point
One Axis Perpendicular to Horizon Line
Three Planes Joined
Projecting Points From True Shape Circle
Vanishing Points
Horizon Line
Station Point
Perspective Axes
Enclosing Solid
Proportion
Inclined Lines
Arcs and Circles in Perspective
Difference Between Oblique, Iso & PerspAxes
Select Correct Position for vanishing Points
Select Station Point
Differences-Circle in True Shape Oblique, Iso, and Persp.

Figure 3. A Learning Sequence.

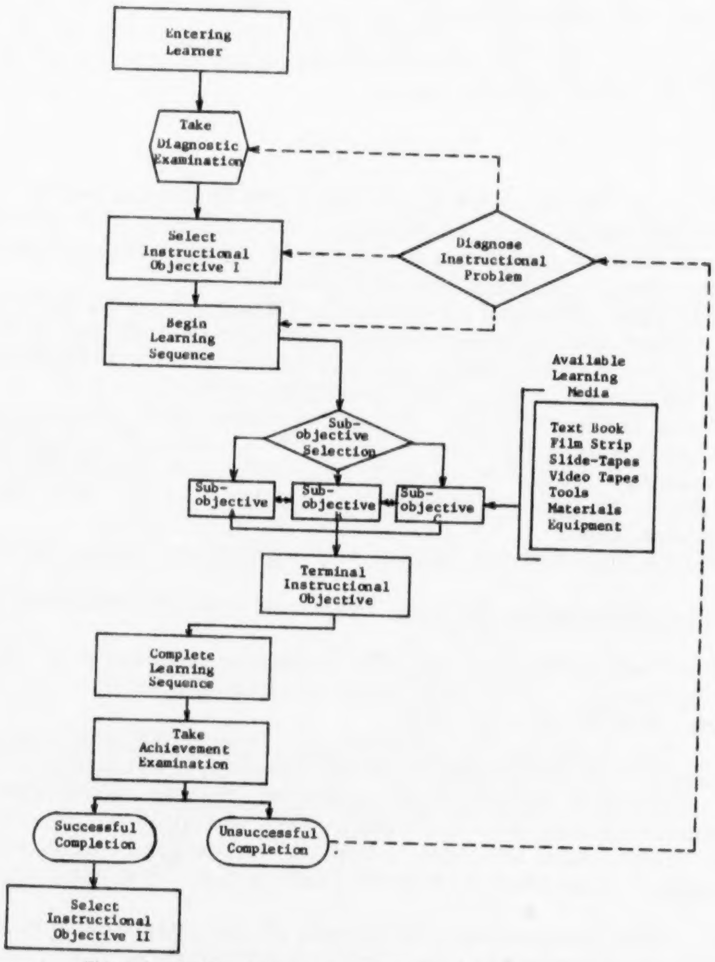

Entering Learner
Take Diagnostic Examination
Select Instructional Objective I
Diagnose Instructional Problem
Begin Learning Sequence
Available Learning Media
Text Book
Film Strip
Slide-Tapes
Video Tapes
Tools
Materials
Equipment
Sub-objective Selection
Sub-objective
Sub-objective
Sub-objective
Terminal Instructional Objective
Complete Learning Sequence
Take Achievement Examination
Successful Completion
Unsuccessful Completion
Select Instructional Objective II

Figure 4. Implementation of an Individualized Instructional System.

The last step in the procedure is the development of instruments that diagnose and monitor individual progress through the learning sequence. Criterion instruments must be prepared to identify student competencies and provide information for determining the appropriate starting point in the learning sequences. Instruments and techniques are also needed to evaluate student attainment of sub-objectives and terminal objectives. These instruments and techniques must reflect the attainment of pupil performance as stated in the objectives.

Implementation of an individualized instructional system. After completing the development of the system, it should be implemented within an instructional program. Students entering a course, or unit of instruction within a course, would be administered a diagnostic instrument designed to identify prior learning, and determine the appropriate starting point in the learning sequence. On the basis of the diagnostic evaluation results, the student would select or be guided by the instructor to his point of insertion into the learning sequence. A student contract could be provided which identifies the terminal objective, learning sequence, achievement criterion and instructional resources. After selecting and utilizing the appropriate instructional resources, the student would exhibit achievement according to the criterion specified on the contract. If the criterion performance is accomplished successfully, the student would advance to another sub-objective or objective in the learning sequence.

In summary, industrial educators should derive tangible benefits from the efforts involved in the development of individualized instruction. The instructional strategy proposed could be applied across the breadth of industrial and technical education at the elementary, secondary and post-secondary school levels. Experience with individualized instruction indicated the approach was successful in allowing students to pace learning according to their ability, utilize time more effectively, and accommodate more students in less laboratory space and less staff utilization (Postlethwait and others, 1969). The process of developing individualized instruction is tedious and time-consuming, but the results could liberate an instructor to become an expediter of learning rather than the imparter of knowledge. Students might then develop an active interest in learning rather than passively submit to instructional pedantry.

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Multi-media individualized approach in teaching electronics

Jim S. Harmon

Introduction. The implementation of newer educational media as a method of instruction is receiving considerable emphasis today. Most impressive is its rapid growth, which has affected all disciplines.

The benefits of newer educational media are unique, since they relate to subjects within the applied sciences and technologies. Among these distinguishing characteristics are the facts that: (1) technological subject matter simply cannot be adequately investigated without extensive use of media; (2) our subject matter must continually change to reflect technological growth (Media environments are more readily updated than are the traditional environments. As an example, information appearing in periodicals can become a part of the media learning environment without the typical lag experienced in waiting for its inception into textbook form); (3) classroom utilization can be increased (This is due to the structural changes offered by media which allow for more flexible use of the facilities); (4) media are also capable of offering important emphasis in enabling one to learn "how to learn" (Within technology specialties, the learner must continually keep pace with advances in his field after he leaves the confines of the educational institution. "Learning how to learn" may well be sufficient to justify media adoption.); (5) media are also adaptable in a unique manner in the general shop environment, where limited facilities and instructional staff often place restrictions on multiple activity learning experiences; and (6) media often enable the teacher to reach learners who have seriously failed in traditional "textbook" environments (For these learners, rewarding media experiences are the result of relationships with less verbal presentations. Films are of considerable value in this instance.).

One problem which confronts technological educators is that media development and application are still in their infancy. We must realize that many questions remain which seek to determine how media may best be applied in learning. At present, although somewhat simplified, it should be realized that educators simply do not know how best to apply media experiences into the curriculum.

This presentation will describe a recent study conducted by this speaker investigating the effective application (which he conducted) of the newer media. Included in this presentation is a brief description of the research environment, of its results, and a reflection on some critical issues which relate to media application within our technological field. For a more comprehensive report of this study, one should preview the dissertation, entitled "Effects of a Multi-Media Environment in College-Level Electronics - 1969 - CSC."

The study. Forty-four learners participated in the controlled study, conducted on the Colorado State College campus one year ago. Each was enrolled as a full-time student, and participated because of being enrolled in "Basic Electricity", offered through the Industrial Arts Education Department.

Criterion measures were the GATB (General Aptitude Test Battery, which measures ability factors), EPPS (Edwards Personal Preference Schedule, which measures psychological factors), achievement scores, personal interview data, and answers to questionnaires.

Student experiences differed considerably from those encountered in most media learning environments. The prime distinguishing characteristic was that the learner was unrestricted in selecting and pursuing any of several different types of media, all of which were daily available and were selected to offer reasonably identical coverage of subject matter. The available media types were four: 16 MM sound films, tape-slide automated presentations, programmed texts and traditional texts. Practical restrictions did not always allow for all four media types to be available daily. However, this was more the exception than the rule. In excess of two hundred films, twelve programmed texts and thirty traditional textbooks were utilized.

The learners received a daily printed listing of the media which were available and adequately covered the topic of investigation. Also distributed daily was a printed listing of study questions which directed activities and were to be answered during the class session. The questions were structured to require more of a "conceptual" than a "factual" type of response, requiring the learner's answers to express a higher level of learning.

Functions of the instructor were twofold: to diagnose and to guide learning. As he was no longer responsible for formal classroom presentations, his released time was spent in permitting discussions with members of the class on a 1:1 ratio.

Testing was frequent, occurring each three to four class sessions. Learners who did not attain acceptable levels of performance were counseled by the instructor to seek corrective measures.

The results. Time does not permit a full description of the results obtained from this study. However, those which relate most significantly are:

Achievement. Term achievement, measured by analysis of test scores throughout the media experiment, differed significantly from that of a normalized distribution, being negatively skewed. These findings suggest that not all learners profited equally nor at an acceptable level. The lowest achievement score was approximately 60%. Low achievers within this study were identified most accurately by the factor form perception; this was negatively correlated with term achievement. Low achievers were also identified as being followers, rather than leaders, are willing to accept the leadership of others, and exhibit low achievement needs. High-term achievers were best predicted from analysis of one's achievement need. When the two factors form perception and intelligence were also considered in a linear regression model, these three factors yielded a coefficient of correlation with term achievement which exceeded .7.

Personal factors. Although the study was inconclusive in its findings as they relate to personal factors, it does suggest that learners may differ substantially in terms of the medium which is best suited. That is, one learner may learn more effectively through use of written media while another may learn best through use of bi-sensory media. One significant finding is that learners who preferred films and tape-slide presentations were less receptive to change and experienced the highest achievement needs.

Most popular media. The medium which received the most praise was that of the automated tape-slide system. This medium was custom-constructed for this experiment by Dr. D. L. Jelden and this speaker. The system consisted of 35 MM color slides which automatically advanced in sequence with a narrative sound tape. The hardware contained a special "stop" feature which required the listener to respond to questions presented. All viewing was within study enclosures equipped with individual headphones.

It is interesting to note that the medium which received the least acceptance was that of 16 MM films. The two hundred films available for this study were edited versions of those presently being used by a branch of the armed forces to teach basic electricity theory.

Group activity. Individual learners were allowed to study by themselves, or to study with a companion. The percentage of time spent by learners in group activity ranged from 20 to 94%. When asked, the majority of learners tended to state that the media environment would have suffered considerably had they been required truly to "individualize" their study habits. This finding tends to suggest that perhaps the social nature of the learner must be recognized in the media environment, and that "individualized" learning best occurs in group action, provided the study group is limited in size.

Single concept presentation. Learners suggested that single-concept presentations may require restructuring. One particular comment was that the "single concept" nature of media lacks articulation of the learner's past knowledge with the present; the learner is not encouraged to assimilate his learnings. Another comment was that single-concept presentations do not allow the learner to understand applications and future need for the topic of investigation.

Motivation. Motivation is difficult to define operationally: it is considerably more difficult to assess. Some partial insight into the relationship between learner motivation and its relation to the media environment was gained through this study. In brief, learners were identified within this study who scored high in terms of class achievement, but did not necessarily seem to have acquired an interest in basic electricity, the course in which the media investigation was pursued. This suggests that perhaps "successful" media must have two prime objectives: to impart knowledge and skills in an efficient manner, and to assure that learning is pleasurable and the learner will wish to pursue future studies within the subject matter.

Within this study, the motivational objective "to score high on a test" seemed to be of greater significance than "to enjoy and pursue electronics".

Study habits. Contemporary literature places minimal emphasis on the objective of enabling the learner to learn "how to learn". This objective, if it can be fulfilled, will provide the learner with the tools to continue his education after leaving the confines of the classroom. As our rapid growth in technological knowledge grows at a brisk pace, we must prepare our present students to continue their learning through individualized efforts. Sixty-three percent of those involved within this study tended to support the thesis that their experience within this study had better prepared them to learn on their own than a traditional environment would have.

Continuance. The learners involved within this study tended to favor the continuance of the media method of instruction. This was interpreted as being very favorable.

A post-study. After having interviewed the learners who participated in this experimental study, and by conferring with Dr. Dave L. Jelden, associate professor at Colorado State College, who generously assisted with this initial study, the need was evident for several changes within the media environment which would lead to more efficient operation. The media method is currently adopted for use in several electricity-electronics courses offered at Colorado State College, and is continually being modified to increase its effectiveness. For those wishing to pursue media studies within technology, it is suggested that they view its implementation on this campus.

One prime structural change which was made within the media environment was to allow for immediate re-cycling of those learners who did not attain satisfactory scores on formal tests. The learner is now required to master content before he is allowed to continue. In one class taught with this technique employed, this speaker was the instructor, and exuberantly reports that all learners within the environment attained formal test averages in excess of 80%. The only grades awarded were A's and B's.

Another change which has been made in the media environment was the development of student packets to guide daily learning. These contain student-graded pre-tests, allowing the learner to assess his mastery of learning. Learners are now allowed to progress at varying rates throughout the term: it is conceivable that some may complete the course in three or five weeks, allowing college credit for knowledge gained, not for a specified number of clock hours of involvement.

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Flexible scheduling: an emerging change in the teaching-learning process

Kenneth L. Schank

An important new concept in education, that of flexible modular scheduling, has been discussed and experimented with in a wide geographic and subject area spread, and is now nearing completion of its first year as a pilot program in one junior high and one senior high school in Racine. Flexible scheduling is an approach to the teaching-learning process which stresses the teacher's professional judgment and emphasizes the student's responsibility for his own learning.

What are the implications for industrial arts in terms of meeting societal demands, goal or objectives achievement, individual development or curricular change? Societal demands are continually changing, so all education must be ready to provide leadership in the change process, accepting systems approaches and moving to the leading edge instead of continually running to catch up. If we agree that the goals which are generally accepted by the majority of the practitioners in industrial arts are sound and achievable, then we must search for new methodology to meet the goals and adjust the content accordingly.

Every teacher would concede that the range of differences in a given tenth-grade class is quite extreme. The students may vary by as much as: two years in age, two feet in height, a hundred pounds or more in weight, eighty points or more in IQ, and seven or more years in reading ability. Maturity scales are not common, but we could grant a wide variation, and motivation for a student's having elected industrial arts might provide more answers than enrollees. If these generalities are accepted, why then are class periods fifty-three minutes in length, and meet five times a week? Why then are the slower learners harassed to keep up with the group, and the faster students restrained because the instructor does not want to give the same demonstration too many times? One might conclude that mass teaching does not insure mass learning.

How then can the content and method of teaching industrial arts be adjusted to compensate for the infinite spread of individual differences? There is a shortage of prepared materials adapted to the individualization of instruction that could be applied to, or superimposed upon, an established program. An exception might be those companies now producing packaged materials in the electricity-electronics area, which tends to be more laboratory-experiment- rather than take-home-project-oriented. The question now arises as to who will be responsible for the development of the materials needed to operate a program of individualized instruction. Obviously the instructors, with the help of supervision, consultants and administration, are best suited. They are aware of the varied abilities needed for the task and also of the time allotments and facilities needed for the specific units of study.

Theoretically, industrial arts on the junior high level is supposed to be exploratory in nature, while the senior high levels tend to go more extensively into depth of knowledge and greater skill development. It is therefore important that the teachers who are involved in a radical approach to education be well grounded in their field and able to sift out and identify that which is important from the substances of lesser priority. Consideration must be given to the basis for selection of these priority items which will form the course content. Analyses such as "trade and job analysis", "materials of industry" and "structure of industry" are but a few of the philosophies which need to be considered, as content and method for the flexible modular scheduling of industrial arts is developed. The background and training, as well as the years of teaching experience, of each of the instructors must be considered. It appears that many industrial arts instructors have been taught, and thus tend to teach, on the comprehensive level. That is, the subject is most often covered in great depth and detail involving repetition, rote memory and testing. Some teacher training institutions are now preparing instructors for a different approach, that of conceptual teaching. Conceptual levels tend to provide insight into the field and lead to decision making. Instructors with a background of this type are quick to accept flexible scheduling and find it easier to adapt to placing the responsibility for learning on the student.

Flexible scheduling requires the instructor to do more extensive and detailed planning than he ever did before. It requires the student to read and write more than he ever expected to do, especially if he started his industrial arts program under traditional conditions. The total planning, for each semester and yearly offering, must be done in such a way that scope and sequence of material will accommodate each student individually.

What are the general formats for individualized instruction? One structure is the large-group instruction, involving a presentation to as many students as could profit from the information. This could include from forty to one hundred. The instructor plans to do three things in the large group: (1) to motivate with audio-visuals, resource persons or teamed presentations; (2) to provide information not easily accessible to students, and (3) to give assignments or direction so that there is something both possible and interesting for each student to do, regardless of individual differences. The use of unipacs, capsules or contracts provides the bases for concepts and comprehensive levels of learning. If we were to look back in the history of industrial arts, one might find these written materials under the names of job sheets, operation sheets, information sheets or assignment sheets.

The next-size group would be that of up to twenty-five or thirty students, depending on physical facility, and would be designated middle group. The small-group activities are generally conducted with from nine to sixteen students. The laboratories/shops are scheduled on an open-lab basis for a number of periods per day, so the structure of a schedule involving small groups is not generally a part of industrial arts planning. Independent study is the core of the total plan, so open-lab time is very important. Resource/study space in the laboratory/shop is also a prime consideration, where the student can use single-concept films, books or other resource materials. In addition, resource materials must be available in the school library for those students wishing to do some of their work there.

Does this mean that skill development is reduced? The answer here is yes, for some students, and yet no for others, in that they can spend more time in the open-lab periods to develop skills to an even greater extent, if that is their personal need.

In summary, flexible modular scheduling is one approach to individualizing instruction. Not all students learn at the same rate, nor do they adapt to change at the same pace. Not all teachers are able to change traditional methods of teaching nor are they able to extract concepts and package or encapsulate materials to continue the learning process, as quickly as others. After just three-quarters of one school year, one can report many good changes, namely a new professionalism on the part of teachers, acceptance by students of responsibility for their own education, and, last, a new look at the teaching-learning process in one high school in Racine, Wisconsin.

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The Partnership Vocational Education Project: pertinent impressions

Ernest L. Minelli

It all began in the summer of 1965, when certain of Michigan's secondary schools, community colleges and industries joined forces with Central Michigan University and The Ford Foundation in the establishment of The Partnership Vocational Education Project, a cooperative effort dedicated to breaking the shackles of tradition and providing the direction to a meaningful and appropriate educational experience for all youth regardless of their individual abilities or occupational goals.

Believing that the educated citizen is an integral part of our rapidly-expanding technological society, Central Michigan University, participating schools and community colleges have discarded traditional curricula and instructional methods and have taken a fresh new approach in an effort to provide students with educational experiences in keeping with individual needs and the demands of our times.

Further recognizing that a meaningful educational experience could no longer be provided within the four walls of the classroom, nor could it be planned, supported and directed by individuals or educational units working in isolation, these institutions pooled their talents and resources with those of certain Michigan industries.

The new program was developed around nine principles which have general application for the development of educational programs for any occupational interest at any level of occupational preparation. Each of these principles is listed below:

(1) The educational experience is vertically articulated from the beginning of formal preparation to completion.

(2) The educational experience is shaped by the demands of individual needs.

(3) The experience offers a balanced program of specialized and general education.

(4) The experience is horizontally correlated.

(5) The educational experience is individualized.

(6) The educational experience stresses intimate pupil involvement.

(7) In designing the educational experience, time, space and instruction are used flexibly.

(8) The educational experience is cooperatively planned.

(9) In providing the educational experience, mechanization of the classroom is essential.

(10) The educational experience is extended beyond the classroom and is the product of a partnership effort.

The program demands of its individual curricula or experiences that which provides for and emphasizes imaginative research and experimentation by its students, and curricula or experiences where rote skills are only a part of its body.

Keeping in mind that the evaluation plan was to be kept flexible in order to make it pertinent and applicable to the action demonstration concept, on which the Project was based, the major undertaking in this area was to assist individual Partnership Schools to identify evaluation activities for general evaluative purposes within and for the individual schools themselves. Information was gathered leading to the preparation of descriptive materials dealing with the salient factors that have contributed to successful programs involving and including teaching personnel, methodology and techniques.

It became apparent early that the Project research faced limitations. For example, statistical comparisons of the programs of the secondary schools participating in the Project were impossible, since there were similarities but no duplicate programs among the school systems. Rather, a diversity of systems and programs existed and still exists. If all Partnership Schools taught the same curricula and employed the same experimental designs, such comparisons would have been possible. It came about, then, that the evaluation plan followed the design of the Project rather than dominated it. As a result of this conclusion, the development of research and evaluation activities was viewed as a process and not as an isolated aspect of the Project.

While the major thrust of the Project was demonstration rather than statistical comparisons, and while empirical research was utilized to arrive at models, the Project nevertheless set forth the following hypotheses:

Hypothesis I: Students in the Partnership Vocational Education Project will show educational growth equal to or greater than students of comparable age and educational background.

Hypothesis II: The Partnership Vocational Education Project will meet the needs of individual students better than would a conventional program.

Hypothesis III: The Partnership Vocational Education Project will develop greater teacher morale than would a traditional program.

Hypothesis IV: Quality of instruction under the Partnership Vocational Education Project will be greater and maintained at a higher level than under a conventional program.

Hypothesis V: Better utilization of physical facilities will be made under the Partnership Vocational Education Project than under a conventional program.

Limited to space and time, the remainder of this paper shall be confined to some pertinent impressions or observations concerning Hypotheses I and II, which are:

Students in the Partnership Vocational Education Project will show educational growth equal to or greater than students of comparable age and educational background.

The Partnership Vocational Education Project will meet the needs of individual students better than a conventional program.

From data collected and analyzed, these summaries may be reported:

(1) The Project students showed educational growth equal to or greater than the comparison group. Further, the Project students showed improved grades over the previous year in all areas of school work.

(2) The students in the Partnership Vocational Education Project had much the same

problems in areas concerning school relationships as did the general student body.

(3) The improvement in school attendance for Project students was clearly visible.

(4) The Project students indicated they felt the correlated activities (horizontal correlation) made the classes more interesting. The general student body surveyed also expressed a similar attitude toward this aspect of the Project. This attitude was noted also by the non-participating teachers and by parents of the Project students.

(5) The correlating and integrating of class activity was a salient feature of the Project and received attention in many free-association responses.

(6) The importance of classroom activity was highly evident.

(7) The Project was productive in changing the students' attitude toward school.

From the data it can be concluded that the Project students did equally as well or better in educational growth than did students of comparable age and educational background, and that the Project did meet the needs of individual students better than a conventional program.

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Individualized instruction: a meaningful educational experience

David L. Jelden

Introduction. We can no longer doubt that we live in an age of rapid expansion. Knowledge is proliferating in virtually every field imaginable. The rate of expansion is explosive. Somehow, man must find his way through a tangled maze of knowledge, assimilate it, and qualify himself to move on into a complex future.

The complexities of our times have developed so rapidly that a startling fact now exists. Of all the scientists that have ever lived -- ninety percent are alive today! The growth of scientific knowledge has accompanied the growth of industrialization. And today, a thorough knowledge of our industrial society is essential to bridge the gap between the present and an increasingly complex future. It is for this complex industrial future that we must prepare our children.

Look at the people around you for a moment. You can hardly help noticing how people differ from each other. Different faces--different statures--different general appearance, different attitudes and preferences. Our children, too, differ from each other. Aside from obvious physical differences, there are less obvious emotional differences. Some, for example, seek companionship. Some, again, do not. No matter what our children are like, we must give them the best education we can by using the best possible methods.

Educational leaders who have studied many problems of learning have turned up some useful facts. They tell us that: the learners' ability to retain the information they study amounts to... "10% of what they read... 20% of what they hear... 30% of what they see... 50% of what they see and hear... 70% of what they say as they talk... and 90% of what they say as they do something."

From these data, we can derive certain essential principles, among them these: students need to develop individual responsibility and the skills of independent study... students need opportunities to develop inquiring minds... students need to learn the skills of effective discussion... they need to acquire far more complex talents for effectual human relations... students need satisfaction in learning. The student who experiences directed problem solving will not soon forget. No amount of verbalizing can replace the perceptions and self-realization gained when the student learns in a problem-solving atmosphere. What better approach to problem solving is there than independent study?

Education: A continual process. To help promote independent study, it is imperative that teachers do not view the process of education as a terminal program.

Teachers should establish an environment in the classroom where the student becomes more responsible for his own education. Far too often, the teacher has been a presenter of information and the student a passive recipient of it. As a result the student did not reap all of the benefits of his learning opportunity. The traditional teacher-lecture system of instruction will not do the job in the years ahead.

Industrial arts has not as yet fallen too far into the crevice of theoretical learning because of its inherent manipulative characteristics. Because of this, industrial arts has been more meaningful to the student than some of the other areas of study. Its manipulative character is part of its uniqueness. Nevertheless, more emphasis should be placed in our teacher preparation programs and in our labs on the individual learning problems of students.

We in education need to develop within our students the individual and necessary *skills of learning* so that the experience obtained in a formal school situation will carry into later life. This does not mean that we need to add more methods courses to our teacher education programs, but that in the classes which we now teach in *all* subject matter areas, the students should have more personal involvement in the learning process. Learning should become an individual, on-going process far after the student leaves the full-time school.

Much has been written relative to the amount of emphasis being placed on gadgets and hardware in modern educational programs. In fact, we may be overemphasizing the gadgetry at the expense of teaching individual learning skills. While industrial arts should make use of all the facilities, techniques and gadgets that it can to increase and enhance learning, these gadgets and bits of hardware should not take the place of a sound understanding on the part of each individual as to how he learns best. We need to teach the technique of learning and the utilization of these gadgets found in educational technology. An innovative approach to education which effectively uses these theories is *learner-controlled education*.

Learner-controlled education: A definition. Learner-controlled education is defined as a system of instruction that is individually-oriented, self-instructional and multimedia in approach. It is based on the premise that students can be taught to interpret the behavior goals of a course, determine procedures that will permit attainment of the goals, and select and carry out the procedure which they consider desirable for attaining the goals. The learner-controlled method is in contrast to the teacher-controlled method, in which the teacher establishes the goals *and* determines the approach by which the outcomes will be reached. In both methods, content, in the main, is determined by the teacher. The methods differ in terms of who determines the procedures for attaining the goals. Putting it bluntly, the teacher does not impose *his* method of learning on the student.

Organization of learner-controlled education. Learner-controlled education (LCE) is organized essentially the same as any other good program of education now in operation. The difference is found in the method of instruction used to achieve the goals of the course. The uniqueness of LCE lies in the general classroom organization and in the freedom and responsibility given to the student in his class work.

Evaluation. The process of evaluation in learner-controlled education will take on a meaning different from the one it has had in the traditional classroom. The emphasis is placed on critical self-evaluation. Tests are administered by the student on his own demand. Items on the examinations are keyed to the master analysis chart to facilitate the reference for more information on the particular topic. There is provision for a comprehensive examination over the entire course which is a teacher-scored final examination. This examination, however, is made up of material which was covered in the self-evaluations taken previously by the students. In addition, there is a manipulative performance examination administered to each student by the teacher at the conclusion of the course work.

Evaluation in the learner-controlled education program takes on another dimension beside that of student progress in course work. An evaluation is made of the aptitudes and personality needs of the student. This is accomplished by having the *General Aptitude Test Battery* and the *Edwards Personal Preference Scale* administered and interpreted to each member of the class in the early part of the course.

This kind of information will allow the teacher to predict in general the success or failure of each student in an individualized program of instruction. By this means those who may have difficulty can be identified early before they experience repeated failure. Research has shown that student aptitudes of intelligence, form perception, verbal fluency and spatial interpretation are closely related to predicting success or failure. Furthermore, statistical treatment of the data identifies spatial aptitude as the most important single aptitude.

Personality evaluation is accomplished by interpreting the results of the scores obtained on the Edwards Personal Preference Scale. This test is an attempt to identify the manifest needs of individuals. It identifies what characteristics an individual possesses and what it takes to make him feel comfortable. The most important characteristics as they relate to the success of an individualized program are achievement, dominance, nurturance, affiliation and change. Of these, research has shown that dominance, nurturance and change have the closest relationship.

Therefore, by looking at the scores in dominance, nurturance, spatial aptitude and change, we can be reasonably sure that, 95 times out of a hundred, the student will probably be successful in an individualized program of instruction. Scores on these traits are in the upper half or above the 50th percentile of an established norm. Likewise, if the student falls below the midpoint in all categories, we can predict difficulty in his completion of the objectives in the course work. This area needs considerable research to validate and verify existing outcomes and hence expand its predictability pattern.

The role of the teacher. In learner-controlled education, the teacher plays a role slightly different from that traditionally believed. Rather than a pure presenter, the teacher becomes a resource person, another source of information that the student can utilize in achieving his goal. The teacher takes on the role of an educational counselor whose primary responsibility it is to make suggestions, pose questions and guide the student to the various resources which enhance and increase the understanding of the topic or problem at hand. The teacher does this by utilizing the information of the individual's personality and aptitudes obtained in the individual evaluation.

The future of education. The basic argument of an individualized method of instruction is that it can and will provide for the flexibility that is needed in future educational experiences. The rapidity of change is making it increasingly difficult for curricula to remain current within the framework of the formal classroom methods that are now commonly used. Further, even if classroom procedures could become more flexible, the traditional method is not amenable to providing for individual retraining and upgrading needs. If man can be taught to teach himself and make use of available resources to attain the needed knowledge and skills, then the retraining and upgrading problem can partially be achieved through individual study.

The solution is not all this simple, however. That man can teach himself is self-evident. The majority of man's knowledge and skill likely is self-taught. It is not self-evident, however, that man is naturally an efficient and effective learner in a self-instructional situation. The success of study skills experiments is testimony to the contention that man's skill at learning can be improved.(2,12) Further, the phenomenon of "learning how to learn" that has been put forth also suggests that man learns this ability, and, if it is learned, then the degree of this learning in any person would be at some point on a continuum from low to high.(7) Learning procedures are not general for all learning outcomes.(6) Learning strategies may differ in efficiency and effectiveness, depending upon whether the outcomes differ in terms such as cognitive, psychomotor and affective. This implies, then, that man should be taught or should learn individually those strategies that are effective or relevant to the learning outcomes involved in a particular task.

Resources for education. Even if man can be taught to teach himself, then there is the problem of his having sufficient resources available for learning what is needed. One of the primary tasks of the educator or teacher in the individualized method would be to know what resources are needed for any learning task and to make these resources readily available to the learner. The efficacy of the provision of a variety of resources and learning materials has been demonstrated for young children. A study reported on a 'responsive environment nursery school' in which one of the essential features is the provision of an 'enriched social, vital world' with which the child can interact.(11) Other studies have reported similar results with young children in enriched settings.(4,9)

The "responsive environment" in a nursery school is essentially an environment in which a wide variety of resources is available for the young learner. The provided variety is not, however, just a random collection of things but rather is a collection of materials in which each component has some purpose.

Although the "responsive environment" procedure has been demonstrated only with young children, it seems reasonable to expect that the same type of situation would operate effectively with other age groups. An adult who is more capable of independent effort than a child should be capable of operating even more effectively than the young child in an appropriate "responsive environment".

Thus, if the student knows the level of knowledge and skill he will be expected to attain and the proficiency he should reach at the end of the course, if he knows the learning strategies that can be effective for him in attaining these ends, and if certain combinations of resources are effective for him in attaining these ends, and if adequate resources are provided, then the student should be able to be self-directive in his study and control his own learning. (This assumes prior knowledge on the part of the individual on how he learns best and sufficient motivation from within.) Further, the learning should be attained more quickly and be more meaningful to the student than it is in the traditional classroom situation. The basis for this expectation is that self-directed learning is generally more motivating, and the enriched environment of the wide variety of resources will allow for a more generalized understanding of the learning because of the opportunity to practice and deal with the concepts in a variety of situations.(5) To promote this self-direction in learning, individual learning activity packets have been developed.

Learning activity packets. The learning activity packets are designed to be used by the student to learn on an individual, self-pacing basis. The educational construct for the learning activity packets can be explained best by reviewing the sequence undertaken by the student as he proceeds through the lesson.

This is not just another lab manual developed to be used in a program as additional activity but is a total 'package'. It consists of behaviorally-stated educational goals, recommended sources of information to achieve those goals, choices of sequence preferred by the student, self-evaluations integrated into the lesson, and a packet evaluation designed to have the student explain in his own words his understanding of the task or educational goals.

To explain in detail the theory behind the development, look carefully at the 'educational flow chart' following. Follow the arrows from section to section as it is explained, beginning on the left-hand side with the circle containing the words "primary objective."

The "primary objective" as outlined on the 'educational flow chart' can be identified as the over-all purpose of the lesson. Simply stated, it asks the question: "What is it that I should understand when I finish with this block of information?" In most instances the "primary objective" can be identified by the title of the packet. The "primary objective" can be compared to the unit title, or chapter heading found in traditional textbooks.

One of the big headaches in any educational experience is the development of individual motivation on the part of the learner. Motivation is in fact one of the most important aspects of any educational experience. Without it, learning does not become an enjoyable, meaningful venture.

The rationale found in the learning activity packet is designed to explain to the student why it is important for him to understand this particular phase of the area under study. It will explain the relationship that exists to future topics or applications in the field and may in some cases develop a relationship to his past experiences. It should answer for the student these continual questions: "Why is it important that I understand this particular lesson? What relevance does it have for my existing world or purpose? What good can I expect from time spent in studying this block of information?" It should appeal to his power of reason and unlock the door to internal drive that is essential to any good learning experience. For some students the teacher may have to supplement verbally the rationale of the lesson.

Once the primary objective and the rationale have been identified and the student sees a good reason for studying, it is essential that the learner understand exactly what it is he should know. To make learning as functional as possible, specific behavioral objectives or tasks can be stated in such a way that the student knows not only what it is he is expected to learn, but under what conditions and to what degree of proficiency the task must be mastered.(14) For example, if an educational goal was stated in behavioral terms as follows:

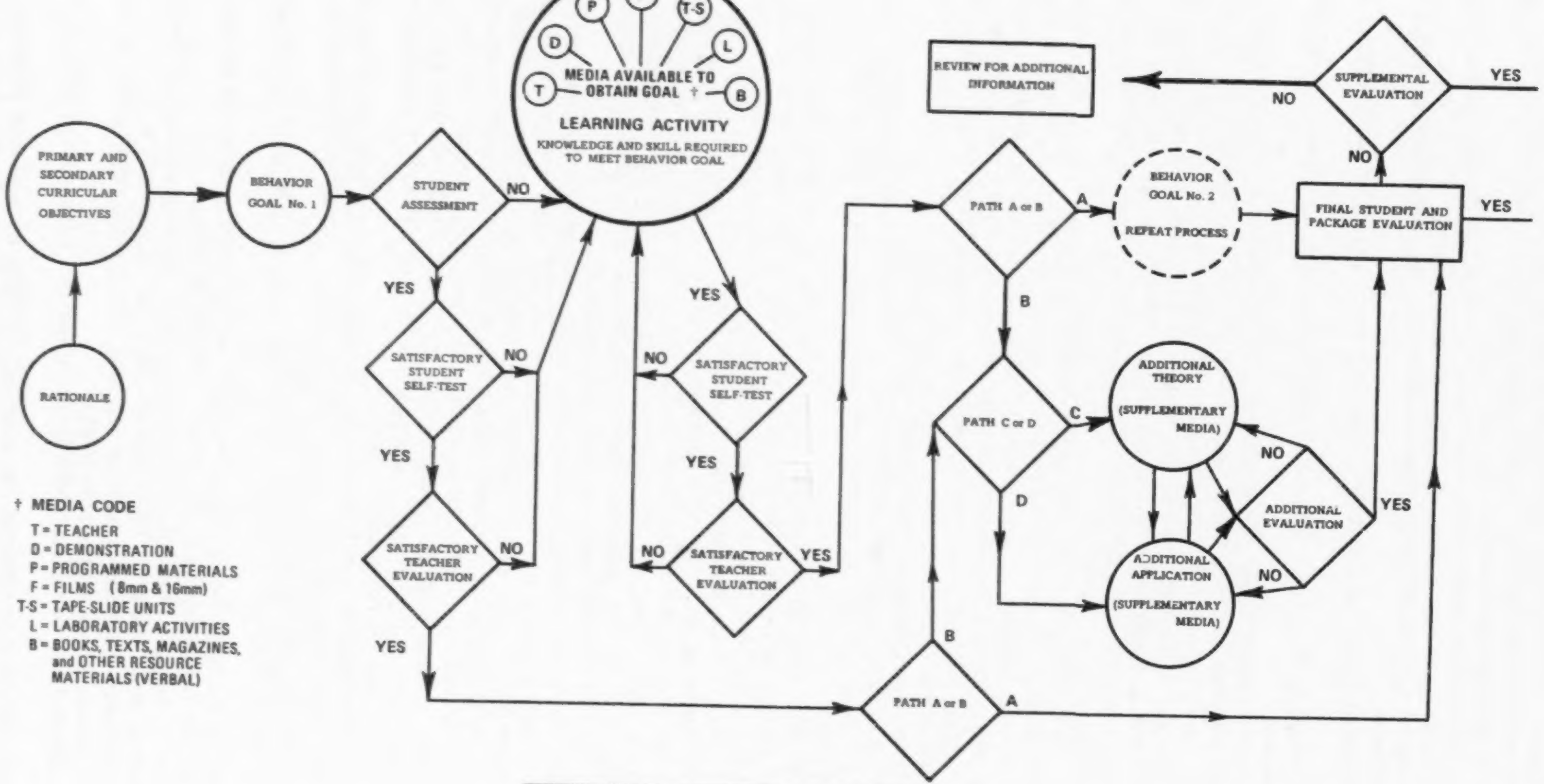
> "Given a schematic diagram of a simple electronic circuit, the student will be able orally, in writing, or by demonstration to identify the components of the circuit from parts found in the test bench and do so correctly 8 out of 10 times."

There would be little doubt in the mind of the learner what was required of him upon completion of the lesson. Likewise, the teacher can make a valid evaluation of the learning experience.

With this kind of terminal behavior, the teacher can structure learning experiences that relate directly to the task, and the student can begin to study those parts of the task that will allow him to perform it under the stated conditions.(15)

In the learning activity packet, the objectives and recommended ways of achieving them have been laid out, so that the student begins the learning process with as much efficiency as possible.

LEARNING ACTIVITY PACKAGE


PRIMARY AND SECONDARY CURRICULAR OBJECTIVES
RATIONALE
BEHAVIOR GOAL No. 1
STUDENT ASSESSMENT
NO
YES
SATISFACTORY STUDENT SELF-TEST
SATISFACTORY TEACHER EVALUATION
MEDIA AVAILABLE TO OBTAIN GOAL †
T
D
P
F
T-S
L
B
LEARNING ACTIVITY
KNOWLEDGE AND SKILL REQUIRED TO MEET BEHAVIOR GOAL
PATH A or B
PATH C or D
A
B
C
D
BEHAVIOR GOAL No. 2
REPEAT PROCESS
ADDITIONAL THEORY (SUPPLEMENTARY MEDIA)
ADDITIONAL APPLICATION (SUPPLEMENTARY MEDIA)
ADDITIONAL EVALUATION
FINAL STUDENT AND PACKAGE EVALUATION
SUPPLEMENTAL EVALUATION
REVIEW FOR ADDITIONAL INFORMATION
† MEDIA CODE
T = TEACHER
D = DEMONSTRATION
P = PROGRAMMED MATERIALS
F = FILMS (8mm & 16mm)
T-S = TAPE-SLIDE UNITS
L = LABORATORY ACTIVITIES
B = BOOKS, TEXTS, MAGAZINES, and OTHER RESOURCE MATERIALS (VERBAL)

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LEARNER CONTROLLED EDUCATION SYSTEM

Dr. D.L. Jelden

One of the primary purposes of education is to make the individual involved develop a valid and reliable method of making judgments about himself. In learning, because individuals differ and because each has a unique background of experiences, an opportunity for students to make self-assessments should be provided.

In the learning activity packet the students are given three choices to determine their degree of understanding of the behavioral task set before them. They are:

(1) I understand ALL of the tasks and therefore have the required knowledge and skill to perform them.

(2) I understand PART of the tasks and will study those parts with which I am unfamiliar.

(3) I understand NONE of the tasks and will proceed with the lesson as recommended by the packet.

By giving the student these three choices, the teacher can identify those who have already attained the stated behavioral goal and can give credit to the learner for the knowledge. In this way the teacher can actually provide an accelerated path for those with previous knowledge. Likewise, for those whose background is not so complete and for those who have not had the opportunity to learn or have forgotten the material essential to completing the stated task, provision in the learning activity can be geared to meet their specific need.

It should be pointed out that accurate judgments on the part of the student can be verified by self-tests. As the learner makes judgments of his educational experience, reinforcement of the quality of that judgment is essential to develop its validity and reliability. In reality, the learner has to take the responsibility for his decisions, and only when he is truthful with himself can he begin the meaningful process of education. The development of a truthful student assessment is a big step toward individualized learning and can be achieved only through opportunity and experience.

At this point on the "educational flow chart", the student must make his assessment of how well the task can be performed and what alternatives are available to him once the choice is made.

For the student who thinks he can achieve the behavioral goal, provision is made in the system to take a self-test over his understanding of the task. The self-test usually involves objective questions and, in instances where required, essay items. Also, in some cases a performance or manipulative examination is required. The idea is that the self-test is a verification of the learner's assessment of how well he can perform the stated task. For those who need help in their evaluation or for those who have questions over material related to the task, the teacher can be involved with the evaluation. If both the student and the teacher are satisfied that achievement of the goal is complete, then the minimum requirement of this objective has been attained.

If additional interest or need is present for some in-depth or concentrated study over and above the minimum task requirements, provision is made for this quest. Information is given to the student at the end of the self-test to allow the learner to obtain additional knowledge and skill in the area under study. The depth of this study is strictly up to the student, and its duration is dependent upon the demands of the teacher or time remaining in the program. This path is identified on the "educational flow chart" as Path 'B', Additional Theory or Additional Application, and is encountered after a successful teacher evaluation of the required behavioral objective.

The other alternative available to the learner, that is, one who does not have any background for completing the task or one who has only a partial understanding of it, is to pursue the lesson recommended by the study guide.

The learning activity packets have a learning activity section which contains several elements:

(1) A list of recommended media available where information can be obtained which will allow the learner to gain information about the task.

(2) A list of helpful study-guide questions that, when answered by the student, will allow him to understand the objective or information related to it.

(3) A laboratory experience, if feasible, that will give an opportunity to apply certain ideas or knowledge on a practical basis.

(4) An information sheet that will summarize the basis of the task or its essential parts.

Once the student has entered the learning activity, he will then proceed to the self-test whenever he is satisfied in his own mind that he can achieve the tasks set forth in the lesson. If the self-test proves that the desired level of achievement has not been reached, a re-cycling back into the learning activity is prescribed. This process is repeated until the student and the teacher can agree that sufficient knowledge and/or skill is present to allow the student to continue into the next phase.

As briefly described under the accelerated track, additional in-depth study can be undertaken by the student if a need exists. It provides some additional sources for the learner to pursue an individual quest to supplement the minimum requirement of the lesson at his leisure. The minimum requirement as identified on the "educational flow chart" is exemplified by following Path 'A' as outlined. The additional in-depth study is charted as Path 'B' and can be approached by the accelerated track from below or from the initial contact track from the top as shown on the chart.

Some larger primary objectives may have several specific behavioral tasks or sections included in them. If this is the case, the student would look at behavioral objective #2 and repeat the process, starting at the student assessment and making the same judgments as described previously.

Upon completion of all the specific behavioral objectives of the learning activity packet, the learner and the teacher must make a comprehensive packet evaluation over the entire assignment. This evaluation may take the form of an oral interview, a written essay test, a laboratory performance test, or any combination of these. It should be realized that the purpose of this evaluation is to get, in the learner's own words or actions, his understanding of the primary objective and his ability to meet the specific behavioral tasks identified in the learning activity packet.

If, after a brief discussion, some voids or discrepancies in the evaluation exist, additional suggestions can be made by the teacher to help the learner improve the overall understanding of the lesson and the completion of the packet.

The learning activity packet is designed to provide for the learner a self-pacing, individualized, multi-media system of education. If used properly, it frees the teacher from highly-structured classroom lectures and allows him to help guide the learning process of the students.

Most of the materials in the learning activity packet provide for self-study. On occasion, a teacher demonstration or lecture may be the best way to present certain kinds of information to a small group of students within the class. What the learning activity packet will do best is provide for the individual differences of the students and place the teacher in the proper professional role as a diagnostician or prognosticator of the educational process rather than a regurgitator of factual information which a machine or some form of educational media might do better.

Assumptions of learner-controlled education. The following statements are some of the basic assumptions on which we base the idea of "learner-controlled education":

(1) It will be improbable and perhaps impossible to keep our schools up to date in a dynamic technological society.

(2) The development of learning skills is as important to teach as the subject matter itself. However, both can be taught simultaneously under a well-structured system.

(3) It is unnecessary to send people back to school in a formal classroom atmosphere for updating as often as some educators have advocated. If the student is properly motivated, continual self-instruction is a reality.

(4) The student is capable of determining his own course of action once he is made aware of the possibilities and alternatives open to him in finding answers to his questions.

(5) A wide variety of resources must be available to the student for an effective individual learning situation. These resources may take the form of many instructional media.

(6) Each student should know or will learn what his strengths and weaknesses are as they relate to how he learns best.

(7) When an educational goal is understood and in some cases, is set by the student, its attainment is more personal, the motivation is stronger, and its achievement more rewarding.

(8) Initially, learning may be slow, but over an extended period more material can be covered better in a shorter period of time. The student will get better, more meaningful learning.

Characteristics of learner-controlled education. The learner-controlled system of instruction under operation at Colorado State College exhibits the following characteristics:

(1) The student will be instructed in the procedures of the course and on the equipment he will be using, and will then work independently.

(2) The content of the course and the goals of the course will be based on a determination of the knowledge and skills required for success in industry. This determination has been completed on the basis of several studies.(1,3,8,13)

(3) The materials will be analyzed and cross-referenced by topics. The learning objectives will be isolated to provide information to students as to which resources are available for the various objectives of the course. This analysis is the heart of the classroom operation. All test items or evaluative instruments will be cross-referenced to the master analysis chart and related to the behavioral goals of the topic under study.

(4) A variety of media is available for the course. The materials will be in the form of several basic media: programmed texts and machines, reference books, slides with tape narrations, tapes, workbooks, 35mm strip films, 8mm and 16mm films, video tapes, overhead transparencies, laboratory equipment and lecture-demonstration by the students and/or teacher.

(5) Evaluation of student progress will be done individually over small blocks. When the student believes he has attained the outcomes of objectives of a given block, he will undertake his own self-evaluation. Immediate feedback will be provided the student, and, if the goal has not been reached, additional study materials or activities will be suggested.

(6) Final grades are determined by a comprehensive objective examination over the informational phase of the course and a performance examination over the manipulative phase. The proficiency level of each part is determined by the teacher and is made clear to the student prior to study.

The cost of individualizing instruction. The learner-controlled education system does not require any new types of materials or any radical changes in curriculum content. It is merely a better utilization of the materials which are already being used by teachers and allowing a greater emphasis to be placed on individual differences and individual initiative. It is understood that because of the traditional teacher-lecture passive student relationship that exists throughout the educational system in the public schools, this new-found freedom on the part of some students will be too much for them to control. In these instances the teacher must make provision to operate on the old teacher-lecture organization on a temporary basis for these students. The responsibility may come slow to the poorer student. This technique of self-teaching is something that will be learned over a period of time rather than accepted at a moment's notice.

Programs in English and social studies for the drop-out have been organized around the learner-controlled concept of education. Experience has shown that these drop-outs have been able to adjust and accept the responsibility for their own education in these areas, provided proper interest, guidance and motivation are available.

As in any new program proposal there are errors, problems and weaknesses. It is felt that these can be overcome and that the advantages gained, from the standpoint of the student and the total educational program, will overshadow the difficulties developed. All in all, it appears that the learner-controlled education system will let us educate our students for the future as well as for today.

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Experienced classroom teacher viewpoint

Arthur H. Schwartz

Through the years, I've had a ball in education. I associate with the academic people, so that a little technology will rub off on them. But I sometimes wonder if a little more of the "rubbing off" shouldn't be on the industrial arts teacher.

A prominent scholar, Dugala Stewart, once wrote: "The faculty of imagination is the great spring of human activity, and the principal source of improvement... Destroy this faculty, and the condition of man will become as stationary as that of the brutes."

Most of us are familiar with the tremendous rate of technological change which has occurred over the past decade. From the imaginative dreamers of yesterday have come the machines, gadgets and ideas that we depend upon so heavily today. For while the world of reality may be limited, the world of imagination is boundless.

Many new ideas are stillborn, and countless others are short-lived and are lost without a trace. Some are only casual thought; others become cornerstones of faith. Some are bitterly resisted; others are welcomed. For some the welcome comes early; for others it is tendered late.

Many correctly bemoan change for the sake of change; others are simply unprepared to pay the price that progress extracts. Everyone has had to react to changes in some way, and each of us has had constantly to readjust his way of life and often even the basic values by which he lives. Sometimes these changes are pleasant; sometimes they are unpleasant. We must learn to live with changes.

We must demand programs where imaginative research and experimentation are commonplace and where rote skills play only a limited part. And above all, we must avoid programs which may result in a lack of general education for the student or lead to an educational dead-end.

It has long been the concern of some industrial arts instructors that the total program was not reaching all students who could profit from industrial arts. The basic areas of industrial arts have been structured in programs and approach. This has been dictated by basic instructional guides and teacher training methods. Traditional courses allow little leeway for exploration, experimentation and creativity.

In my opinion, we must begin by placing the student at the center of the learning process. Around his needs and interests, objectives must be established and learning experiences designed. It is for the student that the school exists, and we must recognize this. All aspects of the educational program must be adapted to and shaped by his growth and development.

Meaningful learning is a product of and should emanate from personal involvement of the student. He should be an active participant in the learning process, not a passive observer. Learning should stress "student doing" rather than "teacher doing". Programs of instruction should foster experiments, research, exercises and various opportunities for solving many different types of problems as well as project-making. They should involve learning experiences which stress logical and critical thinking through the solutions of problems which cut across subject lines.

The student should be allowed to progress at his own rate. We should challenge and stimulate but not force. The able student should not sit idle nor should he engage in busy-work. The less able should never be allowed to fall hopelessly behind while being asked to perform at a pace far above his ability level. Through non-graded or continuous growth programs, together with learning experiences geared to individual abilities, students can be assisted in progressing at their own rates.

The student should be given a degree of freedom. If he is to pursue interests, learn at his own rate, develop self-direction and learn to function as an independent individual, he must be given the freedom to do so. He should be allowed to discover strengths and weaknesses, to fail, to succeed and to experiment with a wide range of personal abilities. If he is to do this, he must be freed, at least for a part of the day, from the narrow and restrictive framework characteristic of traditional systems.

With the many years spent as a classroom teacher, I would have to be classed as a traditionalist who saw the light. I feel that I have always been up-to-date in this field and have seen and felt the "emerging changes in the teacher-learner process with its implications".

I am a firm believer in the comprehensive general laboratory. It has more possibilities, especially in a high school with an enrollment under 1000 students. On this premise I built a good industrial arts program in a strongly academic high school.

I have never been satisfied with my teaching unless I am continually reviewing, revising and enriching the many areas taught with the thought that I give true values to all students who enter my classes. I always keep in mind the different levels of ability.

My laboratory in Fredericksburg has long been known in the state as one that is "where the action is". The lab has six major areas, which are, graphic arts, drafting, ceramics, metal and wood techniques and electricity-electronics. Within these areas we have taught manufacturing and construction. At the present time I have a pilot class for a Title III ESEA innovative industrial arts project, on which I will comment later.

To succeed in any program, the traditional or conceptual, one must come up with the mechanics to make it move. The use of instructional sheets is the answer. The instructional sheet's original use is best explained by its name.

Through the years I have written literally hundreds of them for one specific purpose. The purpose was for continuity, and if some information was not supposedly remembered, it could be quickly referred to, and students could always use them to their advantage.

I have a rule of my own that has proved successful. I have never issued a sheet that is more than what can be put on an 8-1/2- by 11-inch sheet.

Now I'd like to ask a question: Are you really an educator? Are you merely a teacher or instructor, or are you a genuine educator? Think it over.

A teacher or instructor imparts knowledge and skills. He may give much instruction by means of a simple or complex organization of knowledge. He may communicate much detailed information according to any of the well-planned disciplines, but can we call this true education?

To educate, one must cultivate faculties, powers, skills and qualities of culture. Neither faculties nor qualities of culture necessarily will be imparted to a student by routine instruction, or even by the most complex technical details of organized disciplines. This seems to be the gap so highly criticized by business and industry management. There is not enough "wisdom of understanding" communicated to students so that they have any concept of what business is all about when they graduate from school.

The power to reason logically while applying a skill certainly is an element of education which can be encouraged to some extent by a good instructor.

If you are at all competent in your job, the student's ability and motivations are basic tools of your work right from the start. If you are more an educator than a mere instructor, your psychological training and instinct already assist in your efforts to deal with the results of parental environment reflected in your student. But a cultured understanding of the world of industry may be entirely lacking in your training or experience.

In fact, we often wonder how many brilliant minds have gone into the educational field as an escape from the hard-hitting reality of free enterprise. We wonder how many unconsciously cling to the security of a teaching job because they cannot compete in the open arena where their output would rise or fall with market demand and result in some hidden statistic of the gross national product.

This speculation should cast no aspersions on those who are genuine in their dedication to education. This is one of the most vital functions which can be performed for our society, at any cost.

James E. Russell, as secretary of the Educational Policies Commission, addressing the opening general session of this association in St. Louis a few years ago, said, "Educators must be aware that the rise of national knowledge plays a greater role now than at any time in the past." He emphasized the importance of teaching children to think. He went on to say, "The force which is remaking the world is the rational intellect of men, and the man who can earn his own dignity in the future will be the man who can use that force."

Secondary schools should be concerned with curriculum development programs that are structured to provide for teaching the concepts that will more realistically lead to a full comprehension of present-day technology and must provide for the needs of our youth.

And now for a few comments about the Title III ESEA Industrial Arts Program.

During the planning of this project in 1968, I heard Dr. H. I. Willett, Superintendent of Richmond, Virginia, City Schools, make a keynote speech at an industrial arts summer conference. He said this about education:

(1) We must learn to communicate.
(2) We need innovations – this project is one.
(3) Involvement is necessary.
(4) Let's be in tune with our time.
(5) Be able to recognize the elements of change.
(6) Work on developing attitudes and processes.
(7) We must be aware that the students want to know somebody cares.
(8) Give students direction so they can find themselves.

Reason for this course: We must update. We must consider, and

(1) Eliminate cut-and-dried content and lab work.
(2) Teach subject as changing technology.
(3) Offer a wide exposure.
(4) Integrate content of several fields.
(5) Organize content around concepts, key ideas, principles and modes of inquiries.
(6) De-emphasize rote memorization.
(7) Stress inductive things.
(8) Employ the discovery--problem solving.
(9) Undertake evaluation.
(10) Create a group to aid in seeking better ways.
(11) Apply findings from current theories.
(12) Sharpen its identity--greater emphasis on guidance.

When we talk about the elements of change, here are items from the Business Teacher, November, 1968, that point out a number of facts. Much needs to be done to cope with the challenge to provide full educational opportunity in a changing era when:

(1) Fifty percent of the labor force earn their living in industries that did not exist when this century began.

(2) One-third of the items on the supermarket shelves did not exist ten years ago.

(3) Half of all that a person has learned is no longer valid by the time he reaches middle age.

(4) Ninety percent of all drugs being prescribed today were not even known ten years ago.

(5) Three-fourths of all the people employed by industry 12 years from now will be producing goods that have not yet been conceived.

(6) More mathematics has been created since 1900 than during the entire period of recorded history.

(7) Half of what a graduate engineer studies today will be obsolete in ten years; half of what he will need to know is not yet known by anyone.

There are no courses offered that could tie together academic subjects such as English, mathematics, science and art into a technically-oriented approach to industrial functions and techniques. There needs to be a strong attempt to put industrial arts into a real place in the total school curriculum and give it proper perspective. Research indicates the real need for more girls in all areas of industrial arts.

There is a definite need for a course for the average or better student to be able to learn about and familiarize himself with all aspects of industrial and technical communication, both visual and oral. There is a need to search for new methods of instruction that would enliven and vitalize all courses in industrial arts.

The basic idea of the course is to shift the responsibility of learning from the teacher to the student. Instead of merely trying to absorb the material presented by a teacher, these students explore areas of interest to them and in the depth to which they want to go. The accent is on the individual and the decisions that he can and does make. Necessarily, there is an outline to be followed, but it is not as rigid as the ones that most classes have.

Although there is not a rigid plan of action for each day, there is a general designation for each day. Monday is called the Instructor's Day. The instructor uses this day in any way that he thinks is necessary. This includes clarifying things to be done and the presentation of material.

Tuesday is the Student's Day. On this day, the students in the I.G.&C. class pursue their individual projects in the industrial arts lab, I.G.&C. resource room, or possibly the library.

Wednesday is the Presentation Day. At this time various programs are presented to the class. They may range from a student presentation to a representative from 3M Company or a radio announcer. Many of these presentations are video-taped.

A Student Day comes again on Thursday, and Friday is called the Best Advantage Day. Friday may be used for anything that is needed. It may become another Student Day or, possibly, an Instructor Day. It is used to its best advantage.

These days and their designations are generally pretty standard. If a situation comes up in which it may be desirable to change, say, a Student Day to a Presentation Day, the decision rests with the class. The class discusses it and takes a vote to indicate what should be done.

In conclusion, for a few moments let's talk about the teacher. If he is to be effective in working with individuals who will enter a late-20th-century work force, he must have special attitudes and abilities.

The teacher must be a highly capable person. He must be mature, intelligent and ingenious. He must be a professional, committed to the task of educating America's youth in the fight for freedom and an everchanging future.

The teacher must be aware of and concerned with individual differences, and he must provide for progress at individual rates. He must gear instruction to individual needs, challenging and enriching the life of the superior, providing constructive experiences for the average, and offering encouragement to those of low ability.

Not only must the teacher have the capacity to adjust to changing demands, but also he must be an agent of change. He must be in the forefront of technological advancement, changing occupational needs, and the implementation of such for education.

The teacher of the future must be capable of shifting and changing to meet the demands and opportunities afforded each day. His behavior will change from moment to moment, from day to day, adjusting continually and smoothly to the needs of his students, and to the methods and materials at his command.

Mr. Schwartz teaches at James Monroe High School, Fredericksburg, Virginia.

Teaching construction technology

Russell C. Henderly

The Industrial Arts Curriculum Project, "The World of Construction", is a full-year course of instruction for seventh-grade students. The course is divided into five segments. The first segment is merely an introduction and sets the tone for the entire year. The second segment is the study of management technology practices. During these days the students in their laboratory sessions perform many of the management practices that are found in construction.

During the third portion of The World of Construction, the students are grouped together into gangs of five or six. These gangs then perform the practices of construction production technology, such as framing, roofing, plumbing, sheet metal duct work, installing electrical circuits, sheathing, applying siding and dry wall, painting and decorating, as each gang constructs a full-size corner of a frame structure.

Personnel technology practices are studied throughout the entire year, since almost daily we try to help each student identify himself with the practices he is performing that day.

The fourth portion of the course is a review of all construction and is known as "Your Dream House". Each student decides his future income, his family and its needs. He then determines the size, number of rooms and style of his dream house, then prepares a full set of working drawings, scaled 1/4 inch equals 1 foot. From these drawings each student builds his own dream house, using 1/4-inch thick urethene as the building material. This model is completely painted, placed on a site board and landscaped.

The final two-week portion is a game dealing with regional and community planning. Each class is divided into four groups which compete against one another in buying property and developing industry, utilities and services, single- and multiple-housing units, schools, parks and businesses.

Each teacher has a teacher's guide which provides him with a complete description of each day's lesson and laboratory activity. Each student is provided with a textbook and a laboratory manual. The students' reading assignments are usually on an every-other-day basis. The textbook assignments were prepared by knowledgeable persons in the construction field.

The laboratory manual is used in class only and provides each student with well-programmed, interesting and meaningful experiences daily.

Mr. Henderly teaches at Gamble Junior High School, Cincinnati, Ohio.

Teaching manufacturing technology

Everett G. Sheets

The management functions of researching, designing and engineering are stressed during the first half of the course. Four main products progressively carry these concepts from simple levels to the more complex. Personnel practices, also, are studied at this time.

The second semester deals with the production technology of manufacturing. Studies of the processes of forming, separating and combining are stressed. The last main product of the course is a high-intensity desk lamp. This unit of activity draws together in review many of the concepts of the course.

Our teacher's guide outlines in detail a quality lesson for every day in the classroom.

The textbook presents authentic materials written by experts in industry.

The laboratory manual creates student activities that demonstrate the concepts of manufacturing documented by the textbook.

The broad scope of the course in manufacturing provides excellent occupational orientation background for the student as one of the course benefits.

Mr. Sheets teaches at Dater Junior High School, Cincinnati, Ohio.

Individual learning packages

Tom E. Lawson

Essentially, one of the most demanding needs in industrial arts education today is the adaptation of instructional content and activity to individual needs and characteristics. We, as industrial educators, must afford an opportunity for the student to become an autonomous person, taking responsibility for his own behavior, planning his own activities from provided alternatives, and making his own decisions.

To facilitate instruction for providing each student with variations of how, when, what and where to learn, employing efficiently a broad spectrum of learning/stimulant sources, and strengthening on-line, student-teacher communications, a new mode of learning strategy is needed. One such mode involves the development and operative utilization of individual learning activity packages (1). The individual learning activity package is an instructional strategy for providing each student with decision-making options relevant to self-initiated and self-reliant learning. Supportive to this package approach is a systematic arrangement of learning activities which enables the student to select those educational stimulations which seem most germane to his interests and goals in any given time sequence. A total package composite (in addition to the learning activities) must consist of a clearly-defined rationale for the selected concept, performance specifications which reflect the parameter of knowledge and/or skills inherent within the concept, per se, multi-media/multi-mode stimulant sources, and provisions for student self-assessment.

In a conventional manner, industrial arts educators have acknowledged the need for individualized instruction. Unfortunately, however, we have made little or no attempt to conceptualize our selected content and activity to facilitate and assist the student in assuming greater responsibility for his own learning via a packaged approach. Through a packaged synthesis of learning ingredients, students can be given decision-making opportunities relevant to what to study, where to study and when to study, but, at the same time, maintaining the essential criteria of industrial experiences peculiar to the selected concept of concern. Implicit within the structure of the individual learning activity package are selective options wherein the student must actively decide the nature of the content to be studied, the mode of instruction with which he prefers to involve himself, an appealing type of multi-media support, and an activity which seems most relevant to him.

Because of the "self-contained" nature of the individual learning activity package, a student can progress through the composite of learning ingredients at a pace commensurate with his abilities and at a level of sophistication compatible to his learning potential. Hence, the slower student is expected neither to keep up with the "rest of the class", nor to fail. Consequently, the brighter student will not be educationally restricted while the class is catching up. The substantive and syntax structure of the individual learning activity package is as follows (2):

Rationale. Assuming that one specific industrial concept has been identified as the representative package theme, the rationale follows. It is a short explanation to the student as to the significance of the package and its relationship to the total instructional scheme. The rationale must be easy for the student to read and comprehend. Educational jargon, which is most often meaningless to the student, must be excluded. Explanations should be made as to why this particular concept was included within the realm of the course.

Behavioral objectives. Goals or objectives should be stated in terms of the specific behavior to be exhibited by the student at the culmination of any given learning activity. It is impossible to know whether or not a person is learning, since one individual cannot see what is going on inside the head of another. However, the instructor can functionally observe a student's behavior and infer from this perceived behavior that he has profited or "learned".

The following is a correctly-written behavioral objective:

At the conclusion of this package, you will be able to construct, with the use of instruments and drafting media, any two (2) of the three (3) listed geometric structures:

a) parabola (intersection method)
b) ellipse (four-center method)
c) hyperbola (intersection method)

Objectives, reflecting specific performance specifications, must contain the following information (3):

1) Audience
2) Terminal behavior
3) Criteria conditions
4) Degree (success performance)

The "audience" element of a behavioral objective simply refers to the individual or group of individuals to which the objective is directed. In most instances, the pronoun "you" will constitute the audience addressed by the objective--witness the above example.

Terminal behavior refers to the overt behavior you would like your learner to be able to demonstrate at the time your instruction terminates. In the above objective, the term "construct" represents the terminal behavior to be exhibited by the participant. The behavior is a statement of what the learner does and what results from his actions. In stating the behavior of an objective, the criterion for communication should be such that instructors of the same subject matter areas would be able to interpret the described behavior and understand it. Employment of "general" verbs must be precluded, and specific action verbs are demanded.

Criteria conditions refer to the environmental aspects of the performance situation by which the given objective is to be performed. These conditions are limiting factors, specifying exactly what expedients are to be employed by the student in performing the objective, the learning environment, per se, and the nature by which the objective problem-confrontation will be exercised. The phrase "with the use of instruments and drafting media" would illustrate this element of a behavioral objective.

A performance criterion refers to an acceptable minimum standard of achievement. Emphasis must be directed to the required behavior (action verbs) and on how well it must be performed by the student. The degree of success needed to meet the objective is stated so that the student is aware of the absolute minimum acceptable performance. In the example objective, the success criterion is stated as a minimum construction of any two of the three problems. This will vary from student to student in an ideal system.

Pre-test (Self-test). The self-test, which is the third component of the package, gives the student an opportunity actually to assess his inherent capability for knowledges and/or skills prior to his entry into the major elements of the package. Essentially this pre-assessment is a choice item, in that he can either elect to take the self-test to determine his abilities and/or weaknesses or completely omit this inventory and begin the activities. This test, of course, is to be formulated upon the identified objectives of the package, nothing more. However, the self-evaluation may be taken by the student at any time he feels confident in meeting the performance criteria as stated in each objective.

Learning elements. Individualized learning materials, developed for the facilitation of the content and skills implicit in the behavioral objectives, are representative of this component of the package. In most instances, a student will elect to approach this aspect of the package upon exposure to the objectives. However, an individual may be directed to this area as a result of the self-test. In any event, this component of the package must contain a host of media and mode variations supportive to the content of the identified concept. A variety of activities and assignments, with opportunities for the student to make decisions regarding learning alternatives, must be included.

Multi-media and multi-mode options should be available within the structure of the activities and assignments to meet the specific decision sets of each participant. A variety of stimulant sources, such as slides, audio tapes, video tapes, filmstrips, self-demonstrations, etc., constitute multi-media. Interactions between students and teachers, students and materials, or students and students represent modes of instruction. Basically, these modes may be characterized by the amount of personal interaction between the learner and facilitator.

Post-test--final evaluation. When the student feels that he is prepared to demonstrate his ability to perform the objectives of the package, he may, on his own accord, take, or perhaps retake, the self-test, or approach the respective instructor for the final evaluation. The final evaluation inventory is a quantitative/qualitative item structured to measure the objectives of the package and nothing more.

As an integral part of the individual learning activity package, the teacher functions as a resource person and counselor to individual students, as an organizer of learning activities, and, most important, as a facilitator for self-reliant learning. The package approach is quite feasible for all facets of industrial arts content, including skill development as well as industrial knowledges.

Of paramount significance, the package instructional system affords an opportunity for each student in a given population to be treated as an individual learner, characterized by personal knowledges, interests and abilities.

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Technology—the real world

Donald P. Lauda

The 29th annual convention of the American Industrial Arts Association was based upon the theme "Industrial Arts and Technology - Past, Present and Future". During that convention Melvin Kranzberg (1967, p. 33) stated:

> The challenge to industrial arts teachers is especially great. For too long they have been relegated to the basement of our educational system, both literally and figuratively. This situation will only come to an end if and when industrial arts teachers meet the challenge of this new technological age. It will come to an end only when industrial arts teachers develop new curricula to meet the needs of our expanding and more complex technology. Teachers of industrial arts must not only upgrade their teaching of technical skills but also must interest and challenge their students by imbuing them with a sense of the significance of the industrial arts in the past, the present and the future.

The 30th annual convention was based upon the theme "New Concepts in Industrial Arts", followed by the 31st which utilized the theme of "Where the Action Is". This week we are involved in our 32nd annual convention and the theme Man-Society-Technology. It makes one wonder why the term technology is utilized. Why not have used the title "Man-Society-Industrial Arts"? Why not "Students-Projects-Industrial Arts"? Is not the Marshall Schmitt study of 1963 still valid? I would submit, without reservation, that it is.

The American Council of Industrial Arts Supervisors (1969, p.1) developed a document entitled, "Industrial Arts Education 1969 - Purposes, Program, Facilities, Instruction and Supervision", which reinforces my thesis. Their very first sentence says, "The rapid advance of industrial technology has had and will continue to have an overwhelming impact on society." They (p. 1) continue in paragraph three to nurture this position:

> Industrial arts education is designed specifically to help prepare individuals for meeting the requirements of a technological culture. The educated man of today must understand and make judgments regarding the effect of all elements of his environment.

These most encouraging statements immediately give reinforcement to those who understand our technological society. However, in reading beyond these introductory paragraphs, one learns that these writers merely revert to "what is" instead of "what could be" or "what should be". When the purposes of industrial arts are stated, one finds that each places a total emphasis on an understanding of industry and tools without coming to grips with the real issue. This 1969 document, supposedly representative of our cybernetic age, lists the industrial arts courses as: Crafts (Industrial), Drafting, Electricity/Electronics, Graphic Arts, Metals, Power/Automotive Mechanics and Woods.

You may ask, then, "What is the real world?" Many approaches could be taken in answering this question. The "real world" is one in which man's problems are no longer technological, but are rather social, economic and political. Whatever tangibles man demands and requires can be accomplished if he is willing to utilize technology to its fullest potential. However, isn't this the enigma of our society? Man can produce whatever he desires. Unfortunately man creates for the wrong reasons in many instances; for profit, for political power. In other words, his priorities are all wrong.

At a time when the world inventory of natural resources is shrinking, at a time when the industrial bureaucracy mandates dehumanization of the work force, at a time when our astronauts cannot photograph the City of Houston because of smog, at a time when the knowledge industry has become the central capital and the crucial resource of our economy; we must admit that a few select individuals control man and his environment. The Luddites, in the early 1800's, had a solution to technological exploitation. They rioted and destroyed their oppressor. The lemmings solve their problems by drowning themselves in the sea. What are our solutions? Is industrial arts education a part of the solution? Are we secure enough in our discipline to discuss the issues of the day from a historic, economic and sociological standpoint?

Technology is an ongoing process, it builds upon past experience, it "jells" through the efforts of single men, groups and their institutions. Since the 1950's this mushrooming effect has left man with one foot in the present and one in the future. Change in one part of the total system creates changes in all of the other parts. It is man who has created this phenomenon we call technology. Even though he is a latecomer to this planet, his action has been explosive, a process of synthesis, exploration and compendious decision-making. It is this total process that has allowed man to survive. He has drawn upon his own capacity as well as that of others before him in order to cope with the present and to help him adjust to future contingencies. This process has been disruptive yet creative, slow to start but now growing at an exponential rate, reversible in its initial stages, but now totally irreversible.

This process began with discovery as the prime mover, as man proceeded through the "food gatherer" era into the metal era, the craft era, through the industrial revolution and into what we call today the cybernetic era. In the very beginning, man did not have a cultural base with which he could identify as we do today. Today, with change our only constant, man is producing through discovery and invention by leaps and bounds with tools and techniques that allow him to go beyond all of those hurdles that stifled creation in the earliest technological age.

The tools of today are the 30,000 computers, the laser, automation, and all of the other automatic devices developed by man. The purpose of technology from its conception was to disemploy humans – a task in which it is not failing. It is hard to imagine 30,000 computers in the United States, and even more difficult to comprehend the 100,000 which we will have by 1986. At the same time, these creations will be ten times smaller, 100 times faster and 1,000 times less expensive to operate. Lasers are being used to fulfill manufacturing operations, for medicine and for communications. This is the real world.

Peter F. Drucker (1967, p. 31) has stated:

> We are becoming aware that the major questions regarding technology are not technical but human questions, and are coming to understand that a knowledge of the history and evolution of technology is essential to an understanding of human history. Furthermore, we are rapidly learning that we must understand the history, the development and the dynamics of technology in order to master our contemporary technological civilization, and that unless we do so, we will have to submit to technology as our master.

This is the decision that our educational system has to make. Do we or do we not control technology? Invention is a social activity since it alters values or at least poses problems which lead us to question what is, what can be and, most important, what ought to be. Yes, technology crosses the boundaries of the humanities. In fact it crosses the boundaries of every discipline man has created for himself. To say industrial arts is the medium to interpret technology is correct, but only to the extent that it is but a part of the total picture we call education for technological literacy. We might ask ourselves: Can we interpret technology via industrial arts? Is this our task? How should we go about this endeavor?

The technological process requires man to utilize his past, the views of others, as well as every other resource available to him. Industrial arts has a history, it has a present, but whether it has a future in the cybernetic age is questionable. Where technology and industrial arts have been and where they are today are two knowns that we can identify. Man has proceeded through the eras listed below:

ERA	DATE
BONE, STONE & WOOD	? - 6,500 B.C.
METAL	6,500 B.C.
MODERN CRAFT	1,000 A.D.
MACHINE (INDUSTRIAL REVOLUTION)	1776
POWER	1870
CYBERNETIC AND ATOMIC	1953

We can see that industrial arts is a relative newcomer to the age of technology, which has always been a part of man's life. Yet an attentive examination of its history, present stature and future projections reveals that from its very conception it was designed for the modern craft era. Individual craft production, which dominated the scene in the modern craft era, is still utilized in our laboratories in 1970. Oh, yes, we have accepted some contingents of the machine and power eras, but only insofar as they enhance the construction of craft items, that is, projects hand-crafted by individual students.

Man lives in a cybernetic era today. He is faced with a leisure society. He sees crumbling institutions. He sees the bureaucratic structure allowing the destruction of all natural resources. Industrial arts must interpret the "real world", that is, "what is" and "what is going to be", or its existence is in a most tenuous and deservingly suspect position. The Kranzbergs, the Druckers, the Ralph Naders and even a few of our own industrial arts leaders are calling this to our attention, but their cries go into our proceedings as mere historical reflections. Yet, even cursory examination of technology reveals the validity of their remarks. La Technique demands social awareness and conscious efforts to control technology before it controls man.

The fact that we live in a technological society requires that certain information be available and understood by all individuals, so that they can make rational decisions when critical issues come to the forefront. Our society has countless universals reflected in its technology, since technology is social in nature as well as technical. It is these universals that must be conveyed to our youth. Disciplines have fragmented the body of knowledge we call technology; thus the ability to live in a technological society has become almost beyond comprehension. Man continues to live with countless myths about himself, his technology and his culture. In this era of radical change, man is drawn into the future with only these myths and misunderstandings to guide him.

Industrial arts, as a discipline, has a role in transmitting the culture--but the culture as it actually is. Industrial arts is a logical medium for this slice of the educational effort. It has purported to serve this function. Why then are we 970 years behind the times?

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The concept of technology transfer

Ernest G. Berger

As one peruses the contemporary journals in our field, one soon arrives at the conclusion that "teaching technology" is now the new watchword of our profession. Yet, when one visits the public schools, one finds the same programs and the same equipment. The only real change seems to have taken place in the literature and curriculum guides. Perhaps this is due to the fact that so few of us have had the opportunity to really study this thing called "technology", and to "transfer" it into our programs for instructional purposes. In this presentation I would like to explore with you the broad "concept of technology transfer", and how it can be injected into our junior and senior high school industrial arts programs.

I might add that no subject area in the public schools is in a better position to prepare our future citizens for the task of understanding their technical society than is the area of industrial arts.

The idea of "technology transfer" is based on the thesis that the same underlying technology that gave us the Manhattan Project, the ICBM, the Polaris, the Satellites and the Lunar Landing Module can also be harnessed into the service of industrial arts education and unleashed on the problem of closing the technology gap that often exists between education and industrial reality.

I would judge that there are as many definitions of technology as there are teachers in this room. If you will permit, I would like to offer one more definition which we think most clearly defines the term.

Technology is a field of systemized and accumulated knowledge, techniques and intellectual skills and their practical application in creating useful goods and services for mankind. This body of knowledge is derived from a detailed study of the nature, principles, practices and products of science and industry. It is interdisciplinary in nature and involves the application of most of the other disciplines in the solution of technical problems. It encompasses land, sea, air and space environments. For example, science would deal with the theoretical aspects of atomics; whereas, technology applies this basic knowledge in the development of nuclear power plants. I think most of us would agree that our modern society is characterized by its commitment to technology and the benefits it brings to our society.

Examples of these major technologies are: aerospace, agriculture, communications, computers, construction, extractive, management, manufacturing, materials, medical, oceanics, packaging, power, research, service, space and systems. Obviously, there would be some difficulty in attempting to transfer all of these major technologies into the classroom. However, many of these technologies contain rather simple illustrative elements that could easily be "transferred" into useful laboratory experiences. The process by which this is accomplished is "technology transfer."

Technology transfer is defined as the study of various elements from the world of technology and the simplification of these elements or processes into usable "hardware" and "software" instructional units for industrial arts programs.

An example would be the extraction of the "space station" idea from the space technology area and its transfer into a laboratory situation in which a space station simulator is designed and fabricated by the students. Or, the extraction of "teflon" from the materials technology area and transfer into a laboratory learning experience involving students in finding new applications for this unique product.

At this juncture perhaps we need a better understanding of the mechanics of the technology transfer process itself. As you might suspect, the critical phase of any transfer is from the "published" state to the "client" stage, or when the instructional unit is actually ready for student consumption. The technique for accomplishing such transfer is extremely variable. One successful approach is as follows:

Step 1 - SELECTION: Select the major technology area to be investigated. This could well be your major field of interest. Let's assume that area was power technology.

Step 2 - DELIMITATION: Select a small element or process in that major technology for study and development into a usable learning unit of instruction. Example: The fuel cell.

Step 3 - VENTURE ANALYSIS: Recognition of the timeliness of the venture is important. Is it really representative of today's technology? Is it feasible? Are the materials readily available and inexpensive? The person who can best assess the timeliness and practicability of the transfer activity is the individual industrial arts teacher in our schools. Perhaps he has ascertained that it takes only five common items to make a usable fuel cell.

Step 4 - PROTOTYPE DEVELOPMENT: Almost invariably the transfer of technology requires a demonstration of its technical feasibility. Can it be accomplished by the average student in the typical industrial arts lab? After assembling the common elements, he builds the fuel cell and decides that it can be accomplished by average students in a typical industrial arts lab.

Step 5 - DISSEMINATION: Dissemination of process to his students and other teachers. Perhaps this could best be accomplished by publishing the results of his work in our technical and professional journals.

I'm sure you feel as I do that there can be little excellence in education without student interest and desire. A major ingredient in the educational process still is motivation. We have found that technology information and knowledge appeals to the natural interest and enthusiasm of our young people, thereby providing considerable motivation and stimulation to achieve high standards in these substantive areas.

Now that we have reviewed the various steps in the transfer process, let's select one of the major technologies from our previous list and ascertain if these elements would readily lend themselves to the transfer process.

Selecting the area of space as our major technology, we might consider such elements as halography or fiber optics, which might expand and enhance our graphic arts courses.

Utilizing these principles, the 3D motion picture camera and television system is not too far from reality. Under the category of electricity and electronics, we might wish to consider computer transfer. The electronic computer is probably the most prevalent example of applied technology we have in the world today. The scope and depth of the computer revolution is being felt by every individual in our society, and will continue to be felt to a larger degree in the future. Under communications we might consider the possibility of developing a simple computer keyboard and readout device, or a fluidic computer circuit that operates on compressed air. In space technology, communication has been rapidly advanced through the use of the coherent light phenomenon of laser beams. Lasers also have uses as guidance systems for tunnel boring machines, tracking spacecraft and brain surgery.

In the area of materials, honeycomb structures--which is a way of increasing strength while reducing weight--forms an important part of the Apollo spacecraft and the new Supersonic Transport. "Crushable" honeycomb also has a potential use as an energy-absorbing device in automobile frames. This technical element is perhaps the easiest of all to transfer into the industrial arts laboratory and can be demonstrated with a package of 3" x 5" cards. Coating tools and other equipment with plastic through the principles of the "fluidized bed" is another easy "transfer" device.

In spite of what some of our contemporaries say, wood is still here to stay in the space age. It may, however, be used in a different way--as a tool rather than as an end in itself. Space technology utilizes wood to build aerospace simulators, and to test design ideas through the use of scale models. This is another element that transfers readily into our woods programs.

In the area of power, many new technical elements can be extracted for inclusion. For example, in generating electricity by plasma jet, one problem is the containment of hot thermonuclear temperatures, which run as high as 5000°F. This jet is too hot to be contained by any known materials today. It can only be contained in a "magnetic bottle". Such a magnetic bottle can be fabricated and demonstrated, using a simple electromagnetic coil and conventional batteries. Other possible transfers are the "car of the future", "fluidic amplifiers", "the fuel cell", a "tape battery", an "isotopic motor", a nuclear battery using Carbon 14, and a bio-chemical cell that only requires a cup of sugar for fuel every Saturday night.

These are but a few examples of ideas transferrable into our industrial arts programs. There appears to be no limit to the possibilities of transferring the newer technology into existing programs.

It is also possible to transfer new instructional methodology into the education field. A few of these newer directions are research and development, in-depth studies of industries, junior engineering and educational simulation.

In broad brush strokes, these are some of the possibilities for expanding industrial arts horizons through the concept of "technology transfer".

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Technology transfer (through R & D) in higher education

Arthur W. Earl

Technology transfer levels of sophistication will be one of the most crucial educational decisions ever faced during the next decade by the industrial arts teacher education profession. Too long have we complacently followed the traditional non-technical curriculum pattern in industrial arts. The space age era that projected our nation into a technological society demands that sophisticated levels of technical education be extended into every industrial arts teacher education program. The most plausible approach to transferring technological concepts into the industrial arts teacher education program is through Research and Development (R&D).

R&D in higher education. Undergraduate and graduate industrial arts programs should include technology transfer through R&D courses.

The undergraduate courses should expose students to the methodology, prototype development, prototype testing and preparation of technical papers. Then, the industrial arts undergraduate, during the early part of his teaching career, would be capable of upgrading a traditional industrial arts program to a higher level of technology.

The graduate courses should include the industry-university cooperative R&D approach. Exposure to the R&D approach at the master's degree and doctoral degree levels will assist the industrial arts teacher in becoming a higher-level technology master teacher. Also, it will provide the needed research solutions to many critical technical problems that face the industrial arts profession.

Higher education proposed course offerings. A series of several courses would expose the higher education student to the most suitable technological transfer background. A strong case could be developed, based on the high standards of our present technological society, to offer college students an industrial arts major with a specialization in technological transfer. However, if a major or a series of courses is not developed as a part of the higher education program, then students should at least be exposed to the core of the concept in one Research and Development course.

Technology Transfer Higher Education Course Series. The industrial arts major, through a series of seven (7) technology transfer course concepts, would be more adequately trained to teach industrial arts at a technical level.

Laboratory technology courses: New technologies that are presently accepted as a part of our technological society (i.e., plastic extrusion, rotational molding, electrical discharge machining, computer drafting, numerical controlled machining, wood lamination, color separation, etc.), need to be effectively introduced on a large scale into industrial arts teacher education. Much of the laboratory hardware recently introduced on the industrial and education market is suitable for industrial arts education purposes and is within the financial budget arrangements of institutions of higher education. Perhaps the two greatest problems, in this regard, facing the institutions of higher education are: Personnel adequately trained to utilize the hardware most effectively in an educational setting; and sufficiently-developed software to make the hardware an effective teaching aid in the industrial arts classroom.

Industrial Materials Course: The study of raw and processed materials that are the basis of our construction and manufacturing industries is a crucial phase of technology transfer. Insight into material composition, texture, processing, strength and testing is a phase of technology transfer essential to understanding and participating in technology practice. However, too often the industrial arts teacher educator, at the expense of technology transfer, stresses only the technology practice.

Research and Development Course: Technology transfer is emphasized through the problem-solving approach in which the student(s) and teacher together form a technical team to solve applied research problems. A suggested study approach, that emphasizes technology transfer, is to follow the detailed outline method.

I. Problem
II. Procedures
    A. Materials
    B. Equipment
    C. Test Process
    D. Precautions
III. Findings
IV. References

Field Studies of Industry Course: Technology transfer is emphasized through representative industrial visits to note and evaluate management, labor, materials, processes and products of industry.

Cooperative Industrial Work Experience Course: Technology transfer is emphasized through observations, written reports and actual supervised work experience. Therefore, the industrial arts major becomes more aware of the attitudes, skills and knowledge required by modern industry. The industrial arts major is aided in finding meaningful employment (summer), which is directly related to his planned teaching specialization. He is encouraged to register in the course three times, provided each experience is different or more in depth.

Technical Writing Seminar Course: Industry and research organizations, today, stress accurate technical reporting in their professional journals. Regretfully, college English courses offered to the industrial arts major do not stress technical writing. However, industrial technical reporting implies that high-quality technical writing is as exalted as all other types of writing. Therefore, the technical writing seminar will meet the college English requirements and provide an appropriate technology transfer avenue for industrial arts majors.

Independent Study Course: Technology transfer through independent study is designed to encourage the industrial arts major to pursue individual study problems under the guidance of a sponsoring faculty member. The study to be performed will be based on an R&D problem jointly agreed upon by the student and the sponsoring faculty member.

Technology transfer examples. To emphasize the technology transfer concept in the industrial arts teacher education program, technical reports and prototypes of work accomplished by several industrial arts majors are presented.

Selected Papers and Color Slides:

1) An Experiment to Determine the Effect that Aluminum Risers Have on An Aluminum Casting at Different Temperatures
2) A Comparative Study of the Frictional Properties of Two Teflon-S Coated Circular Saw Blades and Two Uncoated Circular Saw Blades
3) Comparative Resistance Characteristics of Ventilated and Nonventilated Automotive Distributor Contact Points
4) A Comparison of Different Eye Protectors to Determine if They Meet the Requirements for Impact Resistance and Penetration Resistance Necessary to Comply with New Jersey Senate Bill S227
5) The Effectiveness of Sterilizing Safety Glasses and Goggles
6) The Effect of Eye Protective Devices on Peripheral Vision

The professional significance of technology transfer in higher education. It is evident that technology transfer can generate many new technical domains for the industrial arts major in higher education, especially when technological transfer is related through a series of courses to the already-existing practical industrial arts program. Technological transfer should not cause "technophobia" for the traditional industrial arts major, because intellectuality is not a necessary criterion for technology transfer. Inspiration, innovation and inventiveness are the true factors that inspire college students to work to their full potential.

The technological transfer gap must be bridged soon in higher education, or the traditional industrial arts program may cause it to become an unbridgeable chasm.

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Technology transfer for the senior high school—the concept in action

Carl A. York

The place of industrial arts in the secondary school curriculum is assured only insofar as it fulfills real needs. The activity concept, synonymous with industrial arts since inception, is an important distinctive characteristic of the discipline. There are some who would de-emphasize the activity, suggesting that cognitive endeavor should supersede it.

The ultimate goal of education is to enable man to solve problems. This premise has been reflected in various goals and objectives for industrial arts. This activity, necessary to solve problems, has evolved with a decrease in emphasis on specific skills and general "craftsmanship". Emphasis of activity should now be in the direction of defining technical problems, researching, experimentation, development and reporting, with "hardware" and "software" items as tangible results. Emphasizing individual research of relevant problems will enrich and complement existing programs and methodology. It could well be a better approach to meeting the objectives outlined for industrial arts.

It has been a goal of industrial arts for years to interpret industry. Yet technology continues to move rapidly forward. This goal must now be rephrased. We must interpret technology. The transfer of technology into industrial arts curriculum is imperative.

The backbone of technology is the research and development (R&D) effort of industry, government and education. The techniques of R&D can be incorporated into any industrial arts program, with the results of problem-solving, independent learning and transfer of technical knowledge to the participating student.

Problems related to or resulting from technology spring up at every hand. It is impossible to mention a few without exciting interest in attempting a solution for one or another. Dr. Delmar Olson (1) proposed several interesting and challenging questions and suggests that industrial arts students might well be the suppliers of answers for some of them. One idea for technology transfer into the high school came from the utilization of "teflon" in the space program. Briefly, "teflon" can be applied to any item which can be raised to a temperature of 725° - 750°F. It can be applied as a sprayed coating to a surface which has been prepared by grit blasting. A very thin primer coat baked at the critical temperature for ten minutes will provide most of the desired characteristics of the coating. Application of an enamel coat is recommended for more durable results and where food preparation or contact is involved. Safety is a concern when spraying the materials, while mixing some of the materials and during the baking process, when toxic fumes are released. Adequate ventilation and a respirator with an acid fume cartridge provide the necessary protection. This technology transfer activity took the following directions:

(1) Background research to determine what teflon was, how it could be applied, the safety parameters and possible new uses for our society.
(2) Determining where the materials might be purchased.
(3) Calls to industry about spray equipment and safety aspects.
(4) Ordering of materials and equipment.
(5) Building an oven.
(6) Technique of mixing materials.
(7) Preparation of items to be sprayed.
(8) Trial spraying and baking.
(9) Analysis of initial results.
(10) Further refinement of technique of coating and baking.
(11) Finished "hardware" item.
(12) Technical report.

In this technology transfer through R&D activity, the instructor's role changes to one of director of learning, coordinator of activities and expediter. He must be willing to concede that he lacks certain knowledge of certain aspects of the problem, while simultaneously exhibiting a genuine interest in learning from the ensuing research of the student.

What about a source of new "technology transfer" ideas? The writer recommends an excellent magazine as a source for these ideas. It is called Design News (2). It is a publication committed to the discovery and publicizing of the latest research and development on technical materials, processes, tools and machines. There are other good sources for ideas and problems. NASA also maintains a technology utilization department which makes publications available. Subcontractors for the space program and the undersea program will make technical bulletins available upon request.

The writer would recommend that all industrial arts teachers and teacher educators investigate and initiate experimental programs in this "technology transfer" approach to learning. The results to date have indicated a tremendous increase in the enthusiasm of the students and an unbelievable degree of interest and cooperation on the part of those in industry to assist teachers and students in this program. The time for transferring new technology into industrial arts programs is now.

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(2) Design News is a Rogers Publication, a subsidiary of Cahners Publishing Co., Inc., 3375 South Bannock Street, Englewood, Colorado 80110.

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Technology transfer (through R & D) for the junior high school

David O. Wilkinson, Jr.

We have seen how R&D can be utilized in colleges and high schools to bring about technology transfer. However, this technique should begin long before students get to high school. In the lower grades students become dependent upon the teacher to the extent that they try to please and do exactly what the teacher asks them to do. They become oriented to grades as a basis of their success or failure. We want the kids to think--to be creative, to be independent--and then we as teachers demand them to recite to us what we have taught them. If we want students to think, we should provide a situation which allows them to be creative. If we want them to assert themselves, we should not place so much emphasis upon failure.

When we talk about research and development, the image which we visualize is that of a college graduate working in a laboratory with all kinds of fabulous apparatus at his disposal. However, when a student, no matter what his age, starts exploring something which is new to him and proceeds to discover all he can about it, he is doing research. To take the information he discovers, and to improve upon it, is development, no matter how insignificant the problem is.

Two years ago, as a participant in an industrial arts NDEA Institute, I came into contact with all different types of industry dealing in space age technology. A question that was constantly asked of the representatives of the industries was, what type of student would they prefer to hire? The answer was universal: A student who wanted to learn, and who would take the initiative to learn; a person who knew how to find out information on his own. They proposed that they would teach a new employee those things necessary to do the specific job required. Research and development techniques teach the students how to learn for themselves, a quality which industry recognizes as an important attribute for its employees.

There are many different types of research and development techniques which can be utilized in a junior high program. One in particular, Project SIAM, was a program initiated at Florida State University as a part of the 1969 EPDA Institute of space technology, with Mr. Berger, Professor of Florida State University, as director and with myself as the instructor. The plan of action, as written in the proposal, stated:

"The primary goal of this experimental project is to immerse a random group of teen-age learners into an environment of intense experience in technology and discovering through related laboratory work, new insights and motivation for creative technical effort. A cross-sectional group of 15 volunteer 7-12 junior high students was recruited for this special six-week concentrated summer program in Space Technology. The design problem was a very real one. The "Astrokids" were presented with the problem of engineering, developing and test-flying a Space Station Simulator. This activity will involve many other disciplines, particularly science, industrial arts and mathematics."

The name SIAM was derived from the first initials of each of the disciplines. The objectives of the program were:

(1) "The learners will demonstrate their new appreciation of the tremendous amount of engineering problems involved in dealing with designing for outer space.

(2) "Learners will develop a proficiency in solving technical problems of an interdisciplinary nature.

(3) "Learners will engineer and develop life support systems to include the air they breathe, shelter, food, clothing, exercise and waste management problems.

(4) "The learners will test-fly their vehicle under simulated space conditions in a hostile environment.

(5) "Learners will communicate through a new and different use of earthbound technology (telemetry, voice and digital systems), by re-adaption and design to fit an outer-space situation.

(6) "Learners will use new materials, instrumentation methods and techniques of fabrication from the spin-off of space technology.

(7) "Learners will actually solve a wide range of technical problems by working with a team of their peers.

Types of activities. "This is an experimental series of interrelated technical junior engineering and development problems which could serve as an enrichment unit in space technology for the junior high school.

"Preliminary study by the author indicates that this approach could be the forerunner of the emerging new course in Space Technology which embraces virtually every field from astrophysics to zoology."

Techniques and methodology. "Before any effective learning activity can take place, it was necessary for the class to become properly motivated to tackle the engineering and development problems to be presented.

"For example, a basic understanding of the total problem should be gained by the learners, with the instructor providing the necessary educational direction and resources to bring this about. Selected films will give the student a visual idea of what has taken place in space colonization and technology to date. Books relative to space stations and space travel were readily available in the laboratory center. Learners were encouraged to write letters (and telephone) to different private and governmental space engineering agencies which disseminate information relating to space technologies and simulator construction. Brainstorming and sketchstorming sessions will be incorporated to help the teams crystallize their thinking on the possible solutions to the main problem. The NASA Briefing Team should be used as a resource, with the team becoming actively involved with the learners.

"After the first week of introductory activity, there would be little formal instruction by the designated instructor or his assistant. The instructors would act as resource persons and provide technical information and guidance when needed."

Preparing the learner. "The instructor would begin early to introduce the psychological aspects of the "Hawthorn Effect" of instilling pride and esprit-de-corps in the learners.

.....Convince the learners that they are doing an important job in helping us develop a course in space technology.
.....Use available "white" labcoats for all team members as well as for the instructors. (Labcoats are labeled "Search" and "Junior Engineering" over the pockets.)
.....Issue special ID cards to be clipped to the lab coats.
.....Assign positions of responsibility with equal authority (i.e., Project Manager, Project Engineer).
.....Use "flight suits" for the 24-hour test flight 3-man mission crews.
.....Advise local press media of the event."(1)

As this program was being conducted, we were taking observations as to its validity. Since many of the students were working on different projects, a test could not be given that would measure what the students had learned. However, we had to make sure that learning was taking place. Many of the results are empirical and were arrived at as the instructor observed the individual activities of the students. I could not itemize what any one student learned; however, I was aware that the learning process was going on. The students utilized the library extensively, wrote letters to industry for information, called people on the telephone and sought out specialists to find answers to problems they had encountered. The program was to start at one o'clock and end at four o'clock each day, but many of the students came in early in the morning to pursue whatever problems they were working on.

There was little or no absenteeism. During the course of the program there was little or no horseplay going on, as each of the students was extremely interested in what he was doing.

Since the course lasted only six weeks, it was difficult to obtain all the research that was necessary for a large project such as this. In a regular school year, however, this could be effectively instigated, and the process of finding the resource materials would not interfere with the overall project.

To assist the teacher in preparing for a program like this, there are a few things that he could do to make a more efficient project:

(1) To have a variety and assortment of materials in the shop.
(2) To have an extensive library.
(3) To have a list of manufacturers' addresses where students can write for information.
(4) To have a telephone available for students' use.

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(1) Ernest G. Berger, JUNIOR ENGINEERING IN ACTION (SPACE), Development Document, Parts I & II, June, 1969.

(5) To contact local industry and gain their assistance in the program.

The most important aspect of the teacher is that he becomes a resource specialist. It is difficult for the teacher not to answer questions about problems when the student asks; however, it *is* a responsibility of the teacher to make the student find out for himself what he wants to learn.

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Technology and man

Donald P. Lauda

During the past several years the industrial arts profession has proposed the study of technology as a plausible discipline base. Toynbee (1961, p. 650), one of our perceptive historians, feels that the study of technology is a major human endeavor equal to the study of economics, politics, art and religion. Yet we, as educators, discuss and advocate the interpretation of technology but are not willing to become involved with the process. Even as college students demand courses which are meaningful and based upon the technological world, we continue to speculate on our roles as industrial arts educators. A Committee Report (1953, pp. 25-26) stated:

> Whatever a man's special function in society may be, he has problems and needs in common with other men. We all face the same world of nature whose laws we must try to understand: we are all subject to the social environment with whose complexity we must deal; and all of us are confronted with similar age-old moral choices. We must have some common understanding of the ideas and ideals on which our civilization depends and which therefore we are not free to ignore. If a democracy shaped not by a picked few but by all of us is to function, we must understand a good many problems--personal, social and scientific--with which men and women even a century ago were not obliged to deal. This is the argument for that general part of a liberal education which is designed to give the skills, the understanding, and the values which all men need, whatever their life work or particular calling.

What has been our role in the total general education program at the college level? To study college and university catalogs, in hopes that one will find industrial arts courses that deal with general education for the technological world, is wasted effort, since such courses are almost non-existent. Those industrial arts courses that are provided to the general student body are usually of the craft variety. This is not to imply that such courses are not valuable, because, as we approach a total leisure society, our contributions will need to be enhanced even more. The writer is raising the question: Are the general education requirements which every college student must meet serving a valid purpose?

One can safely assume that the graduating high school student does not understand his technological society. There is not a single discipline that is making a conscious effort to interpret or help the student interpret his technological culture. A technological society mandates that man have the capacity to use his rational processes, to make value judgments, to adapt to change, all within the bounds of a society which no longer has technological problems. It is no wonder that the college student is asking for "relevance" and for action. He sees the failure of man to solve the problems of ecology, of war, of dehumanization. At the same time he has not experienced personal failure in his mass demands for action and perfection in society--thus the student's boldness in his demands.

The failure of perfection in "social control" in a technological society is a universal feature. It represents a lack of symmetry between the ideal and the actual. The effects of innovations are dispersed in many directions and affect literally every aspect of the culture. These effects often converge to produce a massive effect, which can alter drastically our basic institutions and their concept of normative behavior.

Unfortunately, the concept of "social technology" is a recent one which leaves man in a position where social organization has some "catching up" to do with science and technology. Man's technical ingenuity and the bureaucracy have outdistanced social ingenuity, resulting in social problems of such magnitude that they may be irreversible. A social system requires cohesion, flexibility, tolerance and consistency. Technology has progressed to such magnitude, however, to make this job seem almost impossible. Technology and change have the potential for removing tensions as well as for creating them. This means man's problems are more than technological. They have become economic, political, social and psychological. Each one of these stiflers of the "good life" represents a basic institution which supposedly binds man together. The solution to achieving the ultimate life lies in a blending of technology with social-cultural elements before tangible materials are imposed upon man and his eco-system. Man can no longer be concerned with technology without being concerned with social awareness, and vice versa.

So then, what is our role in general education at the college level? Technology consists of much more than the technical aspects which man and industrial arts programs devote their attention to. La Technique creates a backwash of social consequences, and to study one without the other is wasted effort. To provide a general education course for all students at the college level which deals solely with the technical aspect is doomed to failure before it begins. The entire spectrum must be analyzed – that is, what causes man to create, how does he create, and what are the consequences of his endeavors. One without the other leads students to condemn rather than to become immersed in intellectual activity. This is the problem of current general education requirements at most institutions. The courses revolve around the memorization of facts, concepts that are superfluous, and little recognition is given to the totality of education.

To live in a complex technological society requires the ability to synthesize information, a trait not being conveyed in the traditional "vessel filling" arrangements available today. How can decision making be handled in a class that is meaningless to the student, a class that is based upon impersonal relationship, one where memorization dominates all activities? Jacques Maritain (1943, p. 113) makes this observation when he considers the danger to contemporary education. He says:

> I mean the danger of an education which would aim at making man thoroughly human but making him merely into an organ of a technocratic society.

It was stated previously, by this writer, that students do not study technology at the high school level. Likewise they do not study it at the post-high school level. One might say that attempts are made on a superficial basis by many disciplines, but this approach fragments the totality of the process of education. Therefore, at St. Cloud State College (Minnesota), a plan was executed to provide all students with a class that would unite the many facets of technology. The industrial arts instructor has the technical background which has been established as a prime segment of technology. With this background he is able to analyze our society, calling upon other disciplines for assistance in the social realm if needed to interpret the totality of man and his science-based technology. Ideally this teacher should be capable of providing this totality by himself with what he has gained from his industrial arts programs. However, tradition and naiveté have stifled this potential. What is needed, therefore, is to transform the entire system, to prepare educators who educate educators in the total picture of technology. Until this is accomplished, a general education course based around the concept in question requires an effort of a multi-disciplinary nature. The industrial arts department can and should be the originator of such a program, since it is they that purport to interpret technology. It is they who have the technical background. It is they who have the facility for any research and development activities that might ensue. Department heads must assume a leadership role rather than merely verbalize these goals.

No other discipline has made this attempt. Thus, the challenge for industrial arts is genuine, provocative, exciting, but not formidable. Unless we take action and become leaders in this field of endeavor, the fears of Peter Drucker (1967, p. 31) could come true. He says:

> We are becoming aware that the major questions regarding technology are not technical but human questions, and are coming to understand that a knowledge of the history and evolution of technology is essential to an understanding of human history. Furthermore, we are rapidly learning that we must understand the history, the development, and the dynamics of technology in order to master

our contemporary technological civilization, and that unless we do, we will have to submit to technology as our master.

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Technology and man

Robert D. Ryan

Today we still shout to the heavens that industrial arts draws its content from industry and is general education. The inference can then be made that we teach industry to all students. But look around you in your classrooms. Where are all the students? In reality we are reaching only a few. Why? To use an overused cliche of today--maybe we are not relevant. Could it be that we are not providing what they want?

It appears to me that we are neglecting one of the most important aspects of teaching industry--technology.(1) To be more specific, the history and development of technology, the causal-effects of technology on society and on the future. Industrial arts has traditionally concentrated its efforts upon the materials and processes of industry accompanied by the development of a degree of competence in industrial skills.

The youth of today are presently crusading for a variety of causes, mostly humanistic in nature. They are trying to understand the world we live in and why there are problems. You will agree that many of the dilemmas today are caused by technology and its related factors. Therefore, if youth today do not develop a technical literacy, there will be continued alienation from technology. What we must do, then, is to introduce them to technology, its many facets, and to key issues of today's society.

Let me very briefly introduce a specific example of what I mean. Youth are interested in the new society and environment within which we exist. Many changes have come about throughout the centuries, and now the world, more specifically the United States, has entered into an era where the human race has evolved into a new phase regarding the relationship to the determination of the future. Man now possesses the ability to control, at least to some degree, the future; a possibility quite remote in the not-so-distant past.

Presently, and with increasing determination in the future, the population of basically all plant and animal life, even in the remotest corners of the globe, will be controlled by systematic human breeding, protection, predation and/or pollution--that is, by conscious or unconscious human intervention. The '70's will mark the time when evolution by natural selection is replaced by evolution caused by human intervention. This human intervention is increasingly being planned. The future of our total environment--the planet and its surrounding atmosphere--is no longer being determined by natural evolution, sudden natural catastrophies or by accidents of construction of pre-existing organisms, but rather more and more by planned human actions. It is apparent that now in almost every field, man is responsible for his future.

As we begin to develop this technical literacy, we must build upon causal-effects and problem solving. Fortunately, most adults and youth of today are cognizant of some of the key issues confronting man. If, then, we can capitalize upon this awareness and recognize that there is a new emerging method of problem solving, a method which is imperative for responsibility and accountability and planning for the future, we will have achieved our stated goal--that of general education for all.

The evolution of the three phases of problem solving for organisms is a logical sequence. The first phase was problem solving by survival. To put it bluntly--the survival of the fittest. The second phase was problem solving by learning. This stage came about as man and animals began to learn by their failures and successes. This permitted the organism to project into the future and not repeat that which brought about danger or failure.

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(1) Technology as I perceive it is an all-inclusive term.

The first phase is problem solving by the species as a whole. The second is problem solving by the individual in the course of his existence. The human race has now entered into the third phase of problem solving, which was advanced in the last hundred years or so, the problem solving by science and technology. This has been defined as the method of research and implementation or of study and anticipation. This new method can solve problems in advance, before they become critical. The current jargon for this method is called "simulation" or "develop a model". The computer has advanced this method of problem solving by feedback and cybernetic anticipation far beyond the capabilities of the individual.

Anticipation or projection can often solve problems before they happen or while in progress. The method of problem solving by anticipation is the method for large-scale human organization of knowledge and control.(1)

> Our problems are increasingly becoming problems of human design. Where do our social problems come from? They come from pressures and conflicts, but the trouble is the failure of our designs to deal with these conflicts. They come from the inadequacy of our design and action when confronted with new situations which arrive without adequate anticipation and for which there is no precedent. Or they come from the conflict of human designs when men or groups or nations with competing interests are forced into the same living space.(2)

Let us now return to the specific topic at hand--industrial arts and general education. Eight years ago St. Cloud State College, St. Cloud, Minnesota, recognized this need and set out to fill this void in the curriculum. A faculty member was given released time to design a course which would provide general education based upon technology (industry) for all students.

The first step was to determine objectives. In considering the potential students, it was quickly assessed that the majority would have had little or no contact with industry. Therefore, the only logical approach would be an overview of industry as a whole with the single primary objective--to develop an awareness of technology and its impact on society. At the same time came possibly the most controversial concept concerning the course, that being, strictly a lecture-discussion course which would have no laboratory experience.(3) It was felt that the students are interested in learning about the history, development, organization, causal-effects and future aspects of technology. The next step was to organize the content of the course, select a text and come up with a title.

The basic content was difficult, since few in industrial arts had ventured into this area. As the content began to evolve, it rotated around the following basic areas: 1) Chronology of Technology, 2) World of Work, 3) Mass Production and Automation, 4) Technology and Education, 5) The Labor Force, 6) Technology of Selected Countries, 7) The Future, and 8) Current Issues and Research.

With these basic subdivisions in mind, we began the search for a text. After reviewing many, many texts, a compromise was made because no single text could be found which was felt to be entirely satisfactory. The text selected was a McGraw-Hill publication--Modern Technology and Civilization by Charles Walker. After selecting the text, there was unanimous agreement within the Department that the course title would be the same as the text.

The most difficult step, as most are aware, is "selling" the curriculum council. After considerable debate, it was agreed to place the course in the general education offering of the College as an adjunct, with the understanding that it should be elected only when the "regular" courses could not be taken.(4)

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(1) Ewald, W. R., Jr., Environment and Change, Indiana University Press, 1968, pp. 77-79.

(2) Ibid., p. 80.

(3) The author feels strongly that this approach to the course has been one of the key reasons for its success. There are many who argue, quite vehemently, that in order to teach industry, the student must have first-hand contact with the materials, processes and skills of industry. That appears to be a moot point.

(4) This process took two years.

The pilot offering was scheduled for Spring Quarter of 1964. When the Spring Quarter schedule came out, the course was listed as "Orientation to Industry". The result was a disaster. Only a few students registered, and the course was scratched. Every avenue was pursued to determine how or why the title change came about. It could not be determined. However, the course was rescheduled for Fall Quarter of 1964 under the correct title and seven students registered. It was a beginning. The course was placed into the general education listing as one of a block of four where the students select three.

We have grown from one section of seven students to 47 sections/year with 50 students/section. We will reach about 2250 students this year. There is no question in our minds that we could fill more sections if we had faculty to teach the sections. Our experience has been that virtually every section offered has filled up, with students petitioning to enter the closed sections.

The content of the course has evolved to the following:

I. Introduction
II. Chronology of Technical Advances
III. World of Work
IV. Labor Unions
V. Mass Production and Automation
VI. Free Time - A By-Product of Technology
VII. Education and Its Relationship to Technological Advancement
VIII. Employment
IX. American Industries
X. Food and Population
XI. Technology of Selected Countries of the World
XII. Future Aspects of Technology
XIII. Current Research in Technology
XIV. Current Issues and Events Relative to Technology

The text presently being used is: Fabun, Don, The Dynamics of Change, Prentice-Hall, Inc., 1967.

As the course progressed, the primary objective of--An Awareness of Technology - Its Impact Upon Society--is still foremost. However, a series of behavioral objectives was developed. These are summarized as follows:

(1) Prepare an analysis of the concept "technology".
(2) Describe the American labor force and labor movement.
(3) Follow an industrial organization chart.
(4) Differentiate between mass production and automation.
(5) Compare the technological status of the US with that of other countries.
(6) Define industrial education.
(7) Prepare a research paper on a technological topic.
(8) Define the concept of free time.
(9) Prepare an analysis of a current issue.
(10) Analyze a major American industry.
(11) Discuss employment and its various sub-divisions.
(12) Identify the reasons for increasing population, food crisis, pollution and related issues.
(13) Recognize the impact of the computer on technology and society.
(14) Other objectives as specified by the instructor.

With many faculty instructing the course, it was agreed that there would be a common syllabus and text. The approach to the course content would be the decision of the individual, because it was felt that this method would allow the course to be designed and presented in the manner most interesting and comfortable for the instructor.

There is an interesting sidelight at this point. Almost without exception, all faculty who have been assigned a section of the course have been extremely apprehensive about teaching the course. This feeling is rooted, as we see it, in two areas: 1) Having never taught a complete lecture-discussion course, and 2) a feeling of inadequacy because of the lack of exposure to the wide variety of topics. However, again, almost without exception, the instructors, after having completed teaching the course, are excited about teaching it again. The instructors felt that it had added a totally new dimension to their teaching and understanding of our field. We are the first to admit that the first time through is an extremely difficult experience, because it generally requires extensive organization, reading, and more importantly, a new approach to teaching.

There is no question that our majors must be exposed to this type of an experience in order that they can fill this void present in most curricula. A new role is evolving for those of us involved in "Technology". Until now many have not generally looked beyond the technical functions of materials, processes and machines of industry. We must become increasingly concerned with the causal-effects of technology on society.

If we do not pick up this ball of "technological awareness" and capitalize upon it, some other discipline will. As far as I am concerned, this is the greatest opportunity ever afforded to industrial arts education to impart general education to all.

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Society, human values and technology

Paul W. DeVore

The societal and human concerns of yesterday were different from the concerns of today. The values on which man based his decisions have changed. Man views himself and his world from a different perspective, largely because of the choices some men, not all men, made in the development and utilization of technology.

The social environment of work and the value attached to work by both employer and employee have changed, as evidenced by Company Rules posted in an engineering office in Morgantown, West Virginia, in 1850.

(1) Office employees will daily sweep the floors, dust the furniture, shelves and showcases.

(2) Each draftsman will each day fill lamps, clean chimneys, trim wicks and wash the windows once a week.

(3) This office will open at 7 a.m. and close at 8 p.m. daily, except on the Sabbath, on which day it will remain closed.

(4) Men employees will be given an evening off each week for courting purposes, or two evenings a week if they go regularly to church.

(5) Every employee should lay aside from each pay a goodly sum of his earnings for his benefit during his declining years, so that he will not become a burden upon the charity of his betters.

(6) Any employee who smokes Spanish cigars, uses liquor in any form, gets shaved at a barber shop, or frequents pool or public halls, will give me good reason to suspect his worth, intentions, integrity and honesty.

(7) The employee who has performed his labors faithfully and without fault for a period of five years in my service, who has been thrifty and attentive to his religious duties, and is looked upon by his fellow men as a substantial and law-abiding citizen, will be given an increase of five cents per day in his pay, providing a just return of profits from the business permits it.

(Dominion-Post, March 15, 1970)

Undoubtedly, in those days of free enterprise, low technology and individual freedom, each man regarded work in the best Calvinist tradition. Work was holy and next to Godliness. At least we perpetuate the myth that they did. But things have changed, not only as we view the past and present but as we perceive the future.

Our view of the future is different, if we can believe Ira Levin, author of Rosemary's Baby. The new society will not be run by man but by a gigantic computer, Uni, which calculates the most "efficient" assignments of careers for its many human subjects and, like a computerized dating service gone wild, even mates them. (1, p. 80)

This is the era of high technology, a time of mass confusion. Man's brain seems overloaded. Many are alienated either because they can't comprehend the situation, are totally frustrated in trying to operate within the system or view the system as operating outside of man's control for goals and values alien to man.

Each day men are attempting to communicate the critical social and human issues of the high technology with its high consumption and production. Myths are being exposed and the system challenged through such films as Easy Rider. The evening news broadcast portrays the hypocrisy and mediocrity of government through McLuhan's cool medium of television. Man's traditional values are being questioned, values designed to serve an age long since past.

Man witnesses the myth of equality and democracy in our free enterprise system as he observes first-hand the killing of Black Muslim beef cattle on a Northern Alabama farm, the death of water fowl by oil saturation in the Santa Barbara Channel, or the destruction of English beaches and water fowl by the Tory Canyon ship disaster.

We have witnessed and are witnessing what seems to be a breakdown of social norms and values. Is this breakdown the inevitable result of capitalism, industrialism, technology? What is the relationship between society, human values and technology?

Most men have believed that technology was capable of improving society. We find, however, that technology is a disruptive force. We find it is not possible to introduce new ways into a society existing in equilibrium without disrupting the very continuity of that society. (24, p. 435)

This has been true from the beginning. Technology does disrupt the equilibrium of a society. It does alter values. Witness the account of the Papago Indians when the wagon was introduced into their culture. (25, p. 23) The wagon was a major disruptive force in the society. It brought about changes in values relating to work, the division of labor, economics and the concepts of time, space and distance. The entire society was changed with the introduction of the wagon.

This phenomenon which we have only recently begun to study is not merely a simple addition of new values to old ones. Entire cultural and social patterns are being obliterated. They no longer function with the new technology. Traditional psychological and sociological structures are collapsed. (8, p. 121)

Technology has not received a neutral reception by society. It either arouses great hopes or provokes great indignation. We seem to have no way of determining direction or evaluating alternatives. We seem to be attempting to utilize old values and old societal structures to meet the discontinuity brought about by technology.

Perhaps this is because all of our past historical experience has been of marginal survival. Our past societies have been based on the economics of scarcity, where value and meaning resided primarily in external institutions, systems and objects which aided survival. (13, p. 94) Yet, within a very short time span, man-singular and in small groups, created a technology for man-plural which was beyond his comprehension and which no longer melded with the social and value structures of an agriculturally-based society. Man's values, his criteria for judging his actions, came into conflict with a new reality.

We seem to be unable to understand or predict the results of our actions as we create and put into practice a new technology. Perhaps this is because of the concept of critical mass. (13, p. 20) One application of DDT, one tablet of thalidomide, one birth control pill containing estrogen, one oil spill, one strip mine draining into the mountain streams, one worker displaced by automation, one automobile exhaust or one miner contracting pneumoconiosis, does not create the disruption or destruction that a critical mass of any one of these would evolve.

There may be several reasons for this problem. Man may be living with a myth--the myth of a man-centered, man-controlled world. It is the myth that the world was created for man. Genesis 1:27,28 states:

> *So God created man in his own image, in the image of God created he him; male and female created he them.
>
> And God blessed them and God said unto them, Be fruitful and multiply, and replenish the earth and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.

This was not the view of nature held by the American Indian. Nor is it the view held by many Eastern cultures. The American Indian lived in concert with nature. He believed himself to be a part of nature. Not so Western Man.

It may be that many of our problems develop because technological breakthroughs, such as the atomic bomb or landing on the moon, are, or appear to be, isolated events. (9, p. 101) Even if they seem important at the time, man seems to be lethargic or unconcerned by the happening and returns to the more immediate concerns of bills, promotions, vacations and lawns to mow. Most return to the enhancement of their phenomenological selves. This seems to be a direct result of the mechanical technology with its private

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*Italics added by author.

outlook and division of people and things into minute parts as a means of attaining greater efficiency. But technology continually changes and consequently places man in the position of living in a world of process or continual change.

Today technology is creating a new outlook, a new culture. There is an attempt to view man totally, rather than as a fragmented entity. There is, according to McLuhan, a faith that concerns the ultimate harmony of all beings. The question is whether this new view of man has not come about because of technology and its cybernetic systems, which require planning relating all variables. Is it not technology which is demanding that man view man as a total human being?

Is it not this phenomenon in society which, until very recent times, economists, sociologists, historians and educators have tried to ignore? Is it not technology which has created our social problems and value dilemmas? Does the problem not rest with our simplistic view of technology as "how things are done or made" rather than "why they are done or made the way they are?" (6,p. 2)

Has not technology, rather than dehumanizing man, provided, for the first time in history, a true search for the meaning of man? Have we not reached that stage where the present range and scale of our actions and their consequences require increasing value commitments to specifically preferred and possible futures in human terms? (14, p. 4)

Michael places the issue in proper context when he states:

> There are more dead civilizations than live ones, and I suspect that each of these dead civilizations thought they could always go on the way they always had. (27, p. 364)

Increasing comprehension: We are becoming more and more aware that we live in an age of critical decisions. We are becoming more and more aware that many of our values and institutions no longer provide the basis for judgment nor the means to solve the problems. We have new information and new knowledge about man, society and technology. We have a better historical perspective of technology and a more accurate knowledge of the nature and function of technology within society.

The question doesn't seem to be one of accepting change, for America has always been a nation of change.

> Americans, of course, are quite accustomed to change; in the brief 300 years of settlement, our continent has seen a native Indian culture virtually wiped out, a European civilization, with strong feudal elements, established north and south, a political revolution, a rapid period of road building and continent mastering, a civil war and the destruction of an entire regional economic system, the sudden expansion of cities into megalopolises, the equally sudden appearances of severe economic crises, the shift from a predominantly rural to a predominantly urban economy and culture, the introduction of American voices, guns and blood in international affairs and the development of a spectacular destructive capability, enough to incinerate all life on earth. (27, p. 362)

It is more than change alone, however. At issue is the nature of the change. We live in a time that is qualitatively different from any time in recorded history. The one factor which creates this difference is technology and for several reasons. We have for the first time in history the capability of destroying ourselves along with what Barbara Ward calls the Spaceship Earth. We can do this with great finality because our tools are so powerful and devastating. We realize because of this finality that technology is an important determinant in our lives and that it is time to act in concert and with great deliberateness if we are to understand and control technology for social as well as economic purposes. (15, p. 492)

The human value question is of greater significance than ever before because of the nature of man's alternatives, alternatives created by technology. The options are greater than ever before. The question is: "Which options?" "Which values?" Our society engenders certain values, and therefore our society is predisposed to selecting certain options. The tragedy is that the long-term results of some options, when a critical mass is reached, may be disastrous. Witness DDT or mass production. Upon what values does man base his decisions for the future? Will the old values work?

American society held certain values basic. They stem from Puritan times. The belief in simplicity and the lack of useless ornamentation were values then and may have had a major influence on the development of our technology.

The Americans of Puritan times as well as of succeeding generations had become accustomed to dressing alike and using the simplest implements available because of a whole complex of reasons including the necessities of frontier life. (6, p. 21) This may have made the American public amenable to standardization and had a great deal to do with the success of interchangeable parts and mass production.

Certainly mass production would not have been readily accepted in a society that valued doing one's "own thing" or individual craftsmanship.

This is a key point and directs attention to the issue of technological or social determinism. Do the values that a society holds, together with its social structure, determine the nature of technology? Or does technology determine the values and structure of society? Daniels believes that the direction in which a society is going determines the nature of its technological innovations. He cites studies by the Brookings Institute and by Schmookler, the economist, to support this contention. (6, p. 3)

If it is true that no single technological innovation, and no group of innovations taken together in isolation from nontechnological elements, ever changed the direction in which society was going before the innovation, this means that many researchers have been concentrating on the wrong elements. Rather than identifying the technological elements that apparently give rise to certain social or cultural changes, the effort should be directed toward determining the social structure and value structure which provide the base for certain technological developments. An interesting question to support this point is raised by Daniels.

> What would have happened had the typewriter been invented in a society where the very idea of women in offices was unthinkable? (6, p. 5)

If we as a society are to control technology for human ends, rather than for technical ends, then the question of how to obtain more knowledge and understanding of society, human values and technology is of utmost importance. Certainly the problems cannot be solved by deliverately abandoning our past, forsaking hard-won conceptual tools and values that have served and can serve as the means of introducing rational solutions into the oncoming future. Those who abandon disciplined rational inquiry for some esoteric fantasy accept an unplanned, unpredictable, violent future. The future is unknown, but the lessons of the past and present, when re-evaluated in the light of new information, can provide relatively accurate directions for encountering the unknown future.

Increasingly we are aware that tremendous forces are at work in our society. We are also increasingly aware that the values and social institutions established for the control and guidance of technology are rudimentary. (10, p. 345)

The question is whether man can forego his narrow, individualistic, self-seeking values and work toward conceptualizing the future in humanly desirable terms. Up until now man-singular has been permitted to create and introduce new technologies which have forced man-plural to alter his way of life. During the early history of technology this was not critical, because the technology was not as powerful or as disruptive. Today, however, the changes are not merely extensions of past changes but are "radically new", posing problems which cannot be solved "within the regular format". (27, p. 364)

Man-plural has begun to recognize the great inequalities between the haves and the have-nots. He has come to understand that the world today has become much more interdependent than at any time in history and that the expectations of all people are greater than ever before.

Western man is increasingly concerned. He believes in progress. He values the improvement of the human conditions materially. He believes his institutions can be perfected as can man himself and his society. (14, p. 4)

The new technology has brought with it new tools for man, such as a global communications network. It has also brought to man an increasing awareness of the interrelationship of all men. The new tools of technology, together with man's increasing knowledge, have enormously increased his capacity to choose his future, both collectively and individually. (14, p. 8)

In short, man is realizing that the new problems can be met through the use of the very technologies which disrupted his society.

New questions: He recognizes that the new questions for Western man are not ones of quantity but ones of quality, even though five-sixths of the world's population has not as yet shared quantitatively in the fruits of the new technology. Questions of pollution, privacy and the distribution of the fruits of technological progress receive new emphasis and new awareness by more people. Today, the local power plant is thought of first in terms of air pollution and secondly in its role in producing electricity. The environmental impact of the operation of electric generating stations and particularly atomic generating plants has caused rising public concern.

The public has become concerned to the extent it has stopped or delayed the expansion of electric-power-generating capacity at a number of points in the United States. Even progress on developing hydraulic energy sources has been stalled because of concern for the physical environment.

But pollution is not a new issue. The 1899 Rivers and Harbors Act prohibited dumping refuse into navigable waters. What is new is the critical mass. Recently the Justice Department, using the 1899 act, filed charges against eleven companies, alleging that they polluted Chicago area rivers and canals.

Many, including Lewis Mumford, have been asking us for some time to reassess our values in relation to technology. Mumford cites the work of A. J. Toynbee, who mustered considerable historical evidence to show that beyond a certain point technical progress may indicate human arrest, if not retrogression. The question then becomes:

> *Why should we go on blithely multiplying machines, increasing their power and scope, submitting to the conditions they lay down for their welfare, not necessarily ours? (17, p. 28)

Today the quality of human life in a technological society is one of the questions heard more frequently and by more people. It may be that Western man has been losing his own soul while gaining the whole world for himself. Harvey Cox believes that all of mankind has paid a frightful price for the present opulence of Western Industrial Society, not only the poor nations of the world, whose fields and forests garnish his tables, but also through the impoverishment of the vital elements of his own life, festivity--the capacity for genuine revelry and joyous celebration. Cox is hopeful that these values, that have been starved and repressed during the centuries of industrialization, will be nourished and appreciated again. (3, p. 25)

Perhaps the question can be asked: How much technology does society need? Or, How much technology does society want? There are at least three value orientations from which these questions are answered by man today.

The first position believes that technology is an unalloyed blessing for man and society. (15, p. 489)

(1) Technology is seen as the motor of all progress, as holding the solution to most of our social problems, as helping to liberate the individual from the clutches of a complex and highly-organized society and as a source of permanent prosperity; in short, as the promise of utopia in our time.

The second position holds that technology is an unmitigated curse:

(2) Technology is said to rob people of their jobs, their privacy, their participation in democratic government, and even, in the end, their dignity as human beings. It is seen as autonomous and uncontrollable, as fostering materialistic values and as destructive of religion, as bringing about a technocratic society and bureaucratic state in which the individual is increasingly submerged, and as threatening ultimately to poison nature and blow up the world. (15, p. 490)

The third position does not accord technology special notice, because it has been well-recognized as a factor in social change at least since the industrial revolution.

(3) It is unlikely that the social effects of the computer will be nearly so traumatic as the introduction of the factory system in 18th Century England. Research has shown that technology has done little to accelerate the rate of economic productivity since the 1800's because there has been no significant change in recent decades in the time period between invention and widespread adoption of new technology and because improved communications and higher levels of education make people more adaptable than heretofore to new ideas and to new social reforms required by technology. (15, p. 490)

Thus, man faces value judgment questions as he pursues his secular life style and attempts to direct the future. In years past the common man did not question his tech-

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*Italics added by author.

nology. It was considered a blessing. Today, men everywhere are becoming distructful of and estranged from industrial society, as have the literary man and humanist in the past.

The search is for values that will enable man to live the most humane life ever. The search is being conducted, not in a time of tranquility, but during a period of accelerated technical change marked by a much greater degree of organization and deliberate control. (10, p. 345)

Some men have accepted the challenge. But they find it is hard to predict the future of social conditions when we don't know where we are. Many questions are being raised. Much is being done. No longer do we need to take for granted that when an invention has made a breakthrough there will be no cultural force which can stop the forward thrust.

What is happening is that man has decided to include the social implications in his growing effort to analyze, in advance, all the consequences of a new technology. In short, although there are many positions from which to view technology, good, bad or neutral, the value judgment seems to have been made that man does have a choice.

Society and control: Whether man will exercise his choice will depend on his decisions relating to old values and institutions. The system at present has no built-in control mechanism which can maintain equilibrium and regulate growth. There is much evidence, however, to support the point that the impact of technology will remain germane until there is forged a degree of public control over technology far greater than anything that now exists. (10, p. 345)

This realization comes at a time when the development and application of technology requires an increase in size and scale of our institutions; bigger schools and colleges, bigger government, bigger industry and more interrelations. The transportation and communication technologies have enabled man to disperse over wide areas. Urban complexes have been enlarged, thus creating increases in the size of units to be governed. As a result man is in conflict with his technology. At this stage in development, man's technology seems to be controlling man. It is counter to man's values. Man's social and political institutions are based on specialized, sequential, incremental decision-making. They are directly in conflict with the nature of man. As Crowe notes, man's evolutionary position has hinged, not on specialization, but on generalized adaptability. (5, p. 1106) Thus, man is in conflict with the society he created. This conflict is most evident in our urban centers where there has been a decline in the livability of the total environment that is almost directly proportional to the rise of special-purpose districts. It is the story of specialization, fragmentation and the use of old technologies in an age demanding unification.

The questions today about inequality in our society are the result of the success of technology in making possible the fulfillment of the value of equality. The fact that equality has not been achieved brings forth charges of hypocrisy and alienates large sections of our society. Some believe that whether technology advances in the area of war, the arts, agriculture or industry depends in part on the rewards, inducements and incentives offered by society, thereby indicating that the direction of technological advance may be the result of social policy. (10, p. 343) How much control does society really want to exercise over technology? How much control is society capable of exercising?

Control is being exercised today by values and institutions designed to regulate the present, which in reality determines the future. The problem is that these are out-dated models which still generate the same stereotyped "dilemma" responses to most of our social problems. (14, p. 11)

If man is to control his technology, it is apparent that he must reexamine some of his basic assumptions about his present institutions. In the past the feudal system, the church and monarchies provided direction and control of society. The direction of our society is largely in control of economic, political, business, military and scientific institutions, groups or associations. Will these institutions lead us into the future we desire? Or must new institutions and new societal controls be created? Most observers have concluded:

> existing institutions and traditional approaches are by and large incapable of coming to grips with the new problems of our cities--many of them caused by technological change. (15, p. 495)

This means that if we hope to have all citizens participate in determining future direction, it will be necessary to change our orientation from a purely personal identification with a given structure, solution, way of life or goal, to the enlargement of each individual's sphere of identification from part to whole. (16, p. 40) People must become aware of the whole and not only of the individual parts.

Problems must be approached from a broad, comprehensive, general point of view rather than from narrow, highly-specialized and individualized points of view. Advancing technology has forced man, for his own self-protection, to raise his questions in more human terms. It is forcing man, in addition, to expand the scope of public decision making beyond the narrow power blocs of polity, military, industry or labor.

Reassessment: The social effects of technology force man to state his questions about the future in human terms, alternative possibilities and long-range consequences. We are beginning to see that we are faced with a growing number of decisions about the future use of technology that, in total, may be much more important to mankind than even "the bomb".

The more one probes the issues, the more significant the question of values becomes. Certainly more knowledge is needed. Definitely more information is needed by individuals if they are to participate intelligently. We have prided ourselves in being a rational society which approaches problems in a logical and practical manner. However, it seems as though we do this when we create our technology, but not when we determine its use. Use involves the most personal of values.

> ....questions of values become more pointed and insistent in a society that organizes itself to control technology and that engages in deliberate social planning. Planning demands explicit recognition of value hierarchies and often brings into the open value conflicts which remain hidden in the more impersonal working of the market. (15, p. 498)

Apparently it has been the individual day-to-day decisions that have brought society to the realization that something must be done. We have discovered that decisions made by the individual enterprise of certain preferred groups have brought us to the brink of catastrophe. We have finally asked the question: "Whose business is technology anyway?" And the answer is: "Everybody's." And therein lies the problem. Our society has defined its structures and operational procedures as well as its concept of man, his rights, freedoms and relations to society in pre-industrial terms.

At question is the freedom and rights of the individual in the context of a technological society which enables an individual to possess such tremendous power as well as the determination of future consequences for himself and others for many years to come.

We have cherished the freedom of individual decision making. It is a value of our society. We are reminded, however, that the negative effects of technology we deplore are a measure of what this traditional freedom is beginning to cost us. (15, p. 497)

Great hostilities and much alienation have been generated in our country during this last decade. Men and women have cried out in utter frustration because technology was not being controlled. They cried out because Christian values, constitutional freedoms and other cherished human tenets of our society were being shunted aside in favor of economic and material values. Their frustration was because our society apparently did not and does not have the machinery or institutions for controlling technology for human good. There was no way for man to be heard. Technology seemed to be in control.

Perhaps the issue which precipitated and congealed the greatest student hostility and pointed up the issue of hypocrisy was a technological one--Dow Chemical napalm. The young men and women of our country knew something was wrong, and they found an issue--the military. They shook the complacent middle class. They questioned the integrity of a society which allocates annually more than $80 billion for military and military-related spending. This is one-tenth of our Gross National Product. Even Senators joined the issue. Senator Proxmire not only questioned the allocation of natural resources but also indicated that one of our most cherished values, free enterprise, had been jeopardized. He pointed out that the military, through their business practices, had stifled the principle of open competition and competitive bidding.

The question of natural resource allocation is critical in a free enterprise system. We have established regulatory agencies such as the Federal Communications Commission, the Interstate Commerce Commission, the Federal Trade Commission and the Bureau of Internal Revenue to watch over that which belongs to all of us. However, Crowe (p. 1106) in his investigation finds that no one watches the watchers. The personnel of these agencies come from the ranks of the regulated. Therefore, the communications media are regulated by the communications industry and the transportation media by the transportation industry. We find that what supposedly belongs to all of us is being used for the benefit of the few, the few that have discovered that the control of technology pays and pays well.

The question of society, human values and technology is critical at this juncture in time.

Values are being called into question by technology. Some believe as Ellul does that all values will be technological values and not human values. Others such as Mesthene (p. 501) believe that:

> technology can enhance the values we associate with democracy. But it can also enhance another American value--that of "secular rationality", as sociologists call it--by facilitating the use of scientific and technical expertise in the process of political decision making. This can in turn further reduce citizen participation in the democratic process.

Conclusion: Our knowledge about technological change and social change is very primitive and unsystematic. We have discovered, however, that there are severe limitations to direct technical solutions of social problems.

We are aware that we have the capability of meeting the material needs of society. It is now necessary to create alternative social forms, institutional arrangements and values if we are to meet the more human goals made possible by the developing technology.

Certainly our traditional attitudes and values have proved inadequate to manage the powerful new tools created by man. They have merely perpetuated old solutions and greater insecurities. They have shifted the power from the many to the few.

We have the opportunity to choose our future, provided we recognize that the choice will not be a knowledge decision alone but will be based upon the human value decisions of individuals. Hopefully, man will awaken before it is too late.

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Man's dilemma in the age of technology

John R. Lindbeck

I am sure that most professionals will agree that industrial arts programs are currently being subjected to a serious reappraisal in response to problems posed by a rapidly-changing technical society. The notable outcomes thus far are that we see innovative programs being experimented with and implemented; that the main thrust of such programs is aimed at the junior high school; and that these programs are associated primarily with examining the structure of industries. Of significance, too, are the successes in planning hands-on experiences as integral parts of a field of study which is by tradition sociologically-oriented. There are numerous reasons for these curricular changes, not the least of which is the realization that the industrial arts must, in some measure, contribute to preparing young people for life in a society increasingly pervaded by the technician. Because this subject has been given exhaustive treatment in recent months, including other sessions at this convention, it will not be probed too deeply here. Instead, permit me to outline briefly five characteristics of technology which are of especial concern to industrial educators:

(1) It causes human detachment in that it increasingly removes the individual from an intimate and personal involvement with an act, e.g., the operator of an NC milling machine.

(2) It demands optimum performance because it is machine-oriented, and in so many situations the human being cannot possibly operate as efficiently as the machine.

(3) It requires a commitment to research and development because it feeds on innovation, relative to new processes, materials, methods and products.

(4) It dictates replication of effort by its very nature, in that efficiency relates directly to repetitive actions, e.g., mail ZIP codes or mass production.

(5) It frustrates all of the above conditions because of an accelerated rate of change. Many factors contribute to this feature, such as improved communications, modern management techniques, and the availability of investment capital.

These are the descriptive elements of technology, and I don't suppose there is anyone who would deny their positive contributions. We live better, live longer, live easier than any other people in the world; however, one must admit to the toxic as well as the tonic effects of technology. Its development over the past centuries has brought forth upon this earth amazing technical achievements, medical discoveries, developments of new materials and processes, as well as improving our general standard of living. It also has laid waste to the land and posed some very serious problems for mankind, such as dehumanization, displacement and environmental decay. These contradictions, in my estimation, give substance to the dilemma of man today, and most especially to those responsible for interpreting our technical society to the young. The essential statement of this dilemma is as follows:

> How can we help our students to gain an understanding and an appreciation of the momentous achievements of technology and the necessity for its continued progression; and with equal vigor examine the seemingly insurmountable problems it poses for mankind?

I am not suggesting that we lose sight of the essence of industrial arts and of the powerful motivational force which obtains with hands-on, physical contact with tools and materials. Instead, I am stating that our tendencies to accentuate the virtues of technical proficiency must be tempered with realistic appraisals of the attendant ills. For the remainder of my time, I should like to develop some of the priorities which I feel to be necessary parts of such a technology assessment.

It is a foregone conclusion that automated or semi-automated devices will continue to displace production workers and that the non-computerizable production tasks will become polarized at the extremes of a work continuum. On one end, there shall remain the planning and administering functions, and at the other the very menial jobs requiring minimal training, jobs in short supply and generally undesirable, however important. And of great significance will be the servicing occupations which shall emerge as a vast new professional area. Such jobs can hardly be considered menial. The person performing a service is in fact exercising power, doing something for others that they themselves cannot do. Somehow our students must be instilled with positive attitudes toward the contributions made by workers at all levels, to the end that they will individually recognize the stature achieved through *their* jobs. But in so doing, it is necessary to present a realistic as well as a comprehensive view of the technical world. It is unfair to delude them into thinking that life on the assembly line is to be a joyful experience. It isn't, and won't be anything but a dull assignment for most people. But I feel we can have faith in an informed citizenry to become constructive participants in society.

An additional matter of concern to us obtains with a word which has received currency of late. The word is *ecology*--the study of man's relationship to his environment. Every year Americans junk 7 million automobiles, 1 million tires, 20 million tons of paper, 28 million bottles, 48 billion cans, 165 million tons of solid waste, and we also gush 172 million tons of smoke and fumes into the air. We are responsible for 50% of the world's industrial pollution; it would appear that we have achieved the dubious distinction of being the world's most efficient producer of garbage. Pollution in its many forms has become the bane of the post-civilized society, and it is to our credit that we are beginning to mount a concerted attack upon this most pressing issue. Both information and guidance are called for: we must inform students, reminding them that we are more a society of extractors and discarders than we are consumers and that ways must be sought to channel more of our waste products back into the production cycle; and we must guide them toward the goal of becoming more discriminating consumers. I am conscious of the cavalier manner in which I have skimmed over this topic, but time does not permit a more careful study at this session. It is, however, a challenge with which we shall probably have to come to terms in the very near future.

And finally, we must face the fact of the impersonality of a mechanized world. By way of introducing this element, permit me to read a few lines of poetry which seem appropriate here:

When I heard the learn'd astronomer,
When the proofs, the figures, were ranged in columns
    before me,
When I was shown the charts and diagrams, to add, divide,
    and measure them,
When I sitting heard the astronomer where he lectured with
    much applause in the lecture-room,
How soon unaccountable I became tired and sick,
Till rising and gliding out I wandered off by myself,
In the mystical moist night-air, and from time to time
Looked up in perfect silence at the stars.

To me, these lines by Whitman bring the human problems of technology neatly into focus, for we frequently lose sight of the fact that humanity, not technical efficiency, is, after all, what living is all about. The depersonalization which appears to be a necessary feature of modern society can be crushing to the ego. Just consider the many ways in which we have become "non-persons" in recent years. If you have been in the armed forces, you were a serial number; much of your personal data is filed according to your social security number; while you were attending college, you were assigned a student identification number; your city and state will soon disappear completely from your mail in favor of a far more efficient ZIP code; and how many of you are aware of your name change as you receive those numerous pieces of junk mail innocuously addressed to "occupant"? My point here is not to demean the requirements of efficient record-keeping in this modern age--we most assuredly would be in an even more hopeless muddle without it--but instead to remind us that we must accept the presence of man's frustrations and consider them as we teach about technology. And, too, we must understand his occasional desire to wander off into the mystical moist night air and look up in perfect silence at the stars.

In conclusion, it can be fairly stated that our past studies of industry have been essentially an involvement with the act of transforming materials into products, which acts have become increasingly specialized and mechanized. We have given precious little thought to the attendant individual and societal problems. If we are to respond to the challenge of meaningfully interpreting this technical society to the young, so that they might enter it as active, effective participants, we must correct this program deficiency. To do otherwise would be further to alienate a youth group already somewhat disillusioned with a world condition created by the adult.

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A philosophical basis for technology in industrial arts

Eckhart A. Jacobsen

Introduction. "What a man believes is his private affair; what the citizen in a free society believes is a public affair with ultimate implications for educational, political, economic and perhaps religious decisions."--Anonymous

I wish to state at the outset that this attempt at a philosophical approach to technology in industrial arts must be considered as general or normative in character in terms of the views that ought to be rather than specific descriptive or prescriptive characterizations. Therefore, what is presented here are skeletal assumptions and ideas, the meat of which you as a professional teacher can provide later, relating it to programs, courses of study, method and the like.

We, as functionaries in industrial arts (and as part of the broad field of industrial education), have historically had difficulty in understanding our role (1) in the societal educational scheme of things. Many theoretical writings as well as research and definitions (2) have been attempted in order to resolve this dilemma. Yet, we often still fail to understand ourselves, to establish a direction as well as to study ourselves in depth in order to understand the role that man can play in our society and in the universe of which he is a part.

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(1) Notwithstanding equally historical efforts at defining our field, let alone relating to education and society by ourselves.

(2) It is assumed that, from the positions presented in this paper, the reader already has an acceptable definition of the concepts of "philosophy" and "industrial arts". However, for purposes of this paper, a definition of technology is as follows: Technology is where the pragmatic utilization of mathematics and science tools enters into an operational environment to obtain utilitarian solutions to mankind's problems.

The purpose of this paper, therefore, is to present one man's effort to seek understanding of the universe, of which technological relationships in industrial arts are a part. It is a sincere effort to discuss the sources and the validity of technology as content in industrial arts. The generalizations presented draw upon the many sciences represented in the term technology.

What role does technology play in man's composite cultural picture? No single or multiple exposure to the sciences serves this purpose, yet the technological cause embraces all of the sciences in an operational sense. Hence, analysis and synthesis will be used not only as philosophical method but can be identified as a unique cultural characteristic peculiar to the operational character of technology with reference to the sciences. Concern is held for the sociological function of technology as it influences the nature of society.

Man continues to uncover the principles of science, yet fails to exploit these new forms for his own sociological and ecological benefit. Often narrow-mindedness, limited vision and selfishness are found in the misuse of these scientific discoveries. The man of today, often in technological ignorance, destroys himself as he, the citizen, fails to participate knowledgeably in the cultural solutions of his time. This would include responsible political involvement in issues of social and economic concerns. Man by his technological ignorance often is contemptuous of his contribution to a degenerating environment. All of this is the result of learned behavior, or the lack of it. The educator shares in the responsibility for preparing man and the citizen.

Analysis. "Until now man has been up against Nature; from now on he will be up against his own nature."--Deanis Gabor

In general, one might historically characterize the educational establishment as composed of two distinct systems, often acknowledged as being operationally different. One system may be identified as a closed system (education as a classical experience) and the other as an open system (education that provides also for operational and professional training). The basic assumption of the closed system may be classified as authoritarian and rather inflexible in character; whereas the open system is essentially eclectic and flexible in character. In a closed system, the purpose of education is general, historical and classical, serving selected and sometimes privileged segments of society; whereas the purpose of education in an open system is primarily contemporary, serving the dual causes of general education and training for those desiring it. The inference is made occasionally that classical education per se is a higher-level experience than that found in a curriculum which also provides for training including professional preparation. This position often includes the authoritarian concept that education and training are different. Since they have different relevancies and justifications, they have different placements in the educational establishment.

While this may have been true prior to the twentieth century, it is less true and diminishing, if not nonexistent today. As a matter of fact the reverse may already be the case in the 1970's. It is at this very point in the latter part of the twentieth century that synthesis has taken place between the classical disciplines of science and mathematics, resulting in operational applications necessary to the content of contemporary technology. Because the open system of education has this quality of synthesis, it is most likely that it will, in the decade ahead, supersede the closed system as a more viable system of education. This is due to the intellectual growth potential inherent in the open system when compared to the somewhat static quality of the classical and historically-oriented closed system.

The discovery and implementation of operational applications in terms of cultural need are the most important aspects of technology. Technology is of the sciences, but operationally by and for the people. It is the product of the creative genius of man, a process designed to complement the presence of man in his constantly developing and changing world.

Currently needed is a credible position providing an intellectual bridge between the historical past of the industrial revolution, with its imposed classical prejudices, to an era of contemporary technology. This suggests the necessity for a viable open educational system capable of articulating with the future through a rational and credible position that is mindful of the present and can deal with the future. Too often the educational establishment (industrial education as well as general education) relates to the mirrored past rather than to man's hope for the future, which now transcends the earth into the universe.

These beliefs relate to man's own continuing social needs and his revolutionary drives. By understanding the nature of technology, man at the center of this revolution can then perceive more accurately the future of technology and hence cultural directions. We find that human capabilities are variable. Out of the morass of man's most imperfect historical past, man in the coming years will find it increasingly possible to learn more about himself and his environment. But most important to him is the present opportunity to take a more factual rather than emotional approach to his own being and that of his fellow man. Having the ability to lead creatively and knowledgeably toward an unknown future, man will find it possible to relate more effectively to the total disciplines of his time and hence to the cultural institutions of his society.

Nations often make desperate efforts in utilizing immense quantities of energy and imagination to identify new ways in which technology can serve man better. This is not primarily a technological movement but rather a cultural one. Technology has become a sociological tool and a cultural necessity.

Unlike much of man's history, this new effort toward technological utility is, not the reaction to his past failures but rather, a newly-discovered and -developing intellectual area previously untapped. As an unique intellectual area, it may be viewed as a developing discipline capable of generating its own content.

With the rapid growth of technology, the applied advances in this field require a high quality of selectivity on the part of the decision makers at various levels, whether individual, political or corporate. The scope of technology has broadened and now assumes new dimensions, including social responsibility. From a rather obscure cultural position occupied in the late 1940's, technology has taken on a clearly discernible shape, and become an important operational aspect of governments, education, industry, research institutes and foundations, to name a few; from fantasy to a technical art, and a science form.

Synthesis. "The earth is not a resting place . . . to grow in the midst of dangers is the fate of the human race, because it is the law of the spirit."--René Dubos

Technology as a cultural phenomenon has economic, social, political and even religious relevance. This relevance can be best described as having a comprehensive or total relatedness to societal needs. The essence of this relatedness is best expressed in the Gestalt concept. From the industrial revolution to today's technological evolution, knowledgeable involvement (action) has been its own imperative. The uninitiated and uninformed are profoundly confused and disturbed by what they cannot understand. It can be ecological contamination as pollution, or the use of the electronic computer as a commonly-accepted problem-solving tool, or automated equipment creating unemployment as well as new kinds of employment. It can be the changing educational patterns from arithmetic and equipment skills to the mathematics and science tools essential to contemporary operational learnings that provide new understandings central to the relationships between contemporary man and the multifaceted technology of his time. As technology is continually changing, so, likewise, is man's environment (social, economic, ecological and even the psychological being) and, thereby, of necessity, man himself. Man must sense the importance of his becoming the heir to the future for better or worse. Man is the creator of these cultural dilemmas, and is responsible for social and technological solutions. He must develop his ability to participate effectively in this liberating experience in order that he may perform in the role of co-creator with his fellow men in determining their future cultural destiny, whether socially, politically, economically or even theologically. As well as creator, he should also be the responsible consumer of technology, flying his aircraft, heating his home, disposing of his wastes, driving his car, all emitting ecological contaminents; using someone else's heart by transplant only to find it rejected, discovering technological reasons for metaphysical and religious concerns, unemployment from cybernetic development, utilizing violent means in an attempt to solve societal problems, destroying himself on the highway, or with overindulgence in food, drink or drugs. He is the creator of problems, but he also has the ability and the responsibility to provide intellectual and operational answers. But will he provide solutions? We may have to drive smaller cars, submit to sterilization to fight overpopulation as well as prepare for the underproduction of food, eat less and be healthier, be less selfish personally and more generous with others. But are we totally committing ourselves to these needs?

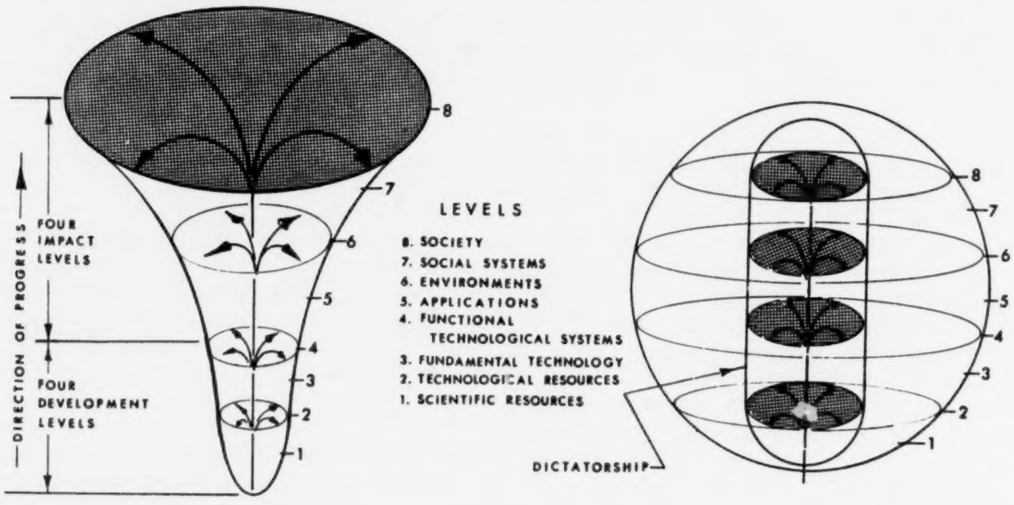
Are we willing to change our behavior by a more relevant technological education?

What we fail to volunteer to do personally, we will be obliged to do collectively by law. Government does only what the people either fail or refuse to do for themselves. Inasmuch as technology is by man rather than of man, technology becomes the servant of man and thus can provide an ever-present potential for improving his lot, if he so chooses.

Admittedly there are problematic relationships between man and his technology that only knowledgeable man can resolve, thus enabling him to remove the often-contrived myths and the cultural symbolic evils attributed to technology. Accepted or not, technology is an accomplished fact to which total man will be obliged to relate, sooner or later, whether knowledgeably or not, in varying degrees. Better, then, that one "light a candle rather than curse the darkness."

As in the past, questions will remain, but operational technology will be an additional cultural tool with which man can deal more adequately with future unknowns. Technological forecasting (as a probability assessment that has been developed to a rather high confidence level) will assist in future technological transfer from scientific principles to societal needs. This transfer (often complex) takes place within a cultural transfer space at different levels in both horizontal and vertical cultural directions. This transfer space is represented by the following illustration entitled "Scheme of Technological Progress".

SCHEME OF TECHNOLOGICAL PROGRESS[1]


DIRECTION OF PROGRESS
FOUR IMPACT LEVELS
FOUR DEVELOPMENT LEVELS
8
7
6
5
4
3
2
1
LEVELS
8. SOCIETY
7. SOCIAL SYSTEMS
6. ENVIRONMENTS
5. APPLICATIONS
4. FUNCTIONAL TECHNOLOGICAL SYSTEMS
3. FUNDAMENTAL TECHNOLOGY
2. TECHNOLOGICAL RESOURCES
1. SCIENTIFIC RESOURCES
DICTATORSHIP

CULTURAL TRANSFER SPACE WITHIN AN OPEN SOCIETY

CULTURAL TRANSFER SPACE WITHIN A CLOSED SOCIETY

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[1] Harvey Brooks, "National Science Policy and Technological Transfer," Conference on Technology Transfer and Innovation, May 16–17, 1966, Washington, D. C.

VERTICAL AND HORIZONTAL CULTURAL TRANSFER

Direction of Vertical Development ↑

Transfer level of Technology	Opportunity and Mission Oriented Characteristics	Examples
2. Technological	Basic technological potential Technological potentials and limitations, required fundamental technological research.	A. Construction and characteristics of: 1. Semiconductors 2. Alloys
1. Scientific Resources	Trends in scientific principles and theories, unapplied knowledge, applicability to technological progress.	A. Atomic structure B. Electron theory C. Electrostatics D. Resistance and current flow

Direction of Vertical Development ↑

Transfer level of Technology	Opportunity and Mission Oriented Characteristics	Examples
1. Scientific Resources (continued)	Absolute (natural) potentials and limitations, required fundamental scientific research.	E. Energy and Power F. Thermal conduction, radiation and convection
5. Applications	Technological, economic and sociological acceptance, measure of "success". Tasks	A. Electrical heating of homes and buildings
4. Functional Technological Systems	Description of system and detailed performance characteristics, development of time, effort and production costs. Relevance of systems to tasks, technological feasibility, cost/effectiveness.	A. Radiant heating units B. Convection units C. Forced air units 1. Heating and air conditioning
3. Fundamental Technology	Functional capabilities, Technological parameters Relevance and feasibility, development gaps, etc.	A. Production and characteristics of: 1. Alloys (bi-metals) 2. Heating elements (nichrome) B. Thermal conductive building materials 1. Radiation 2. Direction C. Insulating materials D. Semiconductor switching devices
8. Society	Impact on Society Social Goals	A. Realignment of the use of natural resources 1. National 2. International
7. Social systems	Impact on national economy, defense, health, etc. National goals	A. Improvement of 1. Environmental and human health 2. Living patterns
6. Environments	Consequences for the structure of industry, leadership of innovative companies Missions	A. Reduction of air pollution and other environmental contaminations

Technological transfer takes place multi-dimensionally in a horizontal as well as in a vertical direction at various levels in the cultural transfer space. Vertical transfer progresses from fundamental science to technology and continues to systems such as processes and products. The impact on different levels, at which horizontal transfer flow takes place in many different directions, may be represented by the following examples:

Direction of Vertical Development ↑

Level 8 - Provided qualifications and visibility to additional social goals
Level 7 - Established foreign policy that includes technical aid
Level 6 - Services sectors throughout industry
Level 5 - Projected need (use) for advanced auxiliary systems
Level 4 - Diffused operational technologies
Level 3 - Synthesized unique technologies
Level 2 - Utilized results of other fundamental technological research
Level 1 - Hypothesized scientific theory

In contrast to the limited concept of "technics", this scheme of technological progress provides for the limitless impact and development of products of technology (technological hardware - equipment), processes, concepts (such as computer software), techniques (such as the heart pump or the removing of environmental contaminates) and so on.

As one progresses upward in the tulip-profiled characterization of cultural transfer space within an open society, one views the multi-dimensional growth potential for total interaction within such a society, with the possibility of an infinite multiplicity of potential developmental directions. While somewhat similar at the first levels, the higher levels of "open" and "closed" societies become markedly different. In the direction of progress, time is an essential dimension in the flow scheme. Horizontal science based upon the integration of technological content at various transfer levels is the current practice and policy of industrial businesses. Also of significance is that the new charter for the National Science Foundation includes provisions for applied technology, thus indicating a shift from what was historically and primarily vertical orientation to a combination vertical/horizontal concept.

In the foreseeable future the concept of technology presented here will be an influential component in determining the nature and growth in the volume of fundamental research. It will also provide encouragement and direction necessary to fundamental research related to social goals (therefore industrial arts) as well as assisting the Federal government in its political commitments.

Speculation. "Luck is a residue of careful planning"--Anonymous

Technological innovation (both social and industrial), being normative in character, can be greatly enhanced by a responsible citizenry prepared educationally in the technological content of industrial arts.

The societal growth gap, as related to the synthesis between technological knowledge and sociological need, can be immensely improved by means of an educated citizenry, with knowledgeable involvement rather than ignorance and frustration.

Educational concern for the technological will strengthen vertical technological transfer as well as a horizontal development within the cultural transfer space in an open democratic society.

Current developments in service and applied technologies will broaden the potential technological horizons, thus identifying with the burgeoning need and increased concern for horizontal technological transfer. It is in this area that industrial arts and the generic field of industrial education can so admirably serve the needs of contemporary society.

A more definitive "operational action concept" commitment to technology (in industrial arts and industrial education) will hopefully tend to lessen the "obsession" to definition and planning that often subconsciously seeks to avoid commitment to action.

A commitment to the operational action concept will support a change from product-project-oriented learning experiences to process-function-content-oriented learning experiences, utilizing to a greater degree technological content in research and experimentation as learning experiences.

Generalized technological curricular planning provides convenient adaptive characteristics having relevance to educational and social needs. Such a normative approach provides greater visibility to the process of relating technological change to educational objectives.

A more homogeneous and total consideration of the sociological, economical and political relationships to educational function will facilitate the utilization and application of the concept of technological transfer levels within cultural space.

The promise of man's future is not in the evolutionary progress of technology but rather in the manner in which he utilizes that technology.

Industrial arts can be the unique educational carrier of technology to the young people in the public schools in what often can be characterized as an alien technological society.

A new definition of industrial arts: Industrial arts is a systematic study of technology and its relationship to life and the universe in totality. It provides a logical system of general ideas basic to the interpretation of human experiences in an open society.

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Technology in industrial arts: operational aspects

W. R. Miller

The nature of industrial arts. The study of industry and its associated technology is basic to the program of industrial arts. As formally organized in the school program, it is a body of subject matter planned to develop competencies, understandings and attitudes related to industry and technology. Learning experiences involve activities such as experimenting, designing, producing, servicing and evaluating through the application of tools, machines and processes which provide opportunities for creativity and problem solving. It should be acknowledged that industrial arts is a multi-faceted program that can help youth achieve a number of objectives, but in my view, the central purpose relates to the interpretation of industry and technology.

The present frame of reference for industrial arts is based upon the concept of an educational continuum ranging from general to specialized education. General education is recognized as common learnings which are desirable for all--to make us more alike--the centripetal force in our society. Specialized education encompasses those school experiences designed to take into account unique interests, needs and abilities of individuals --to make us desirably different--the centrifugal force.

The systematic study of industry and technology is an essential part of the education of all youth from the elementary school through college. Therefore, a certain amount of exposure to a study of industry and technology can be justified as general education. Beyond the exposure that can be justified as "common learnings for all", programs of industrial arts would do well to structure their offerings to meet specialized interests, needs or abilities rather than to contend slavishly to be "general education". Hopefully, I can resist the temptation to expound on my personal preference regarding instructional strategies that are "best" to interpret industry and maintain a perspective that acknowledges no best way has yet emerged.

Background of the presentation. In preparation for this presentation, a careful review was made of the professional literature, related to this interpretive function, which emerged during the decade of the '60's. In addition to the review of the literature, contact was made with teachers, many of whom were recommended by 29 of 45 state supervisors of industrial arts contacted. We asked the supervisors to recommend teachers who had engaged in special activities designed to assist youth in gaining a greater appreciation and understanding of industry and the associated technology.

From this input we have structured this presentation in an attempt to provide you with a broad picture of our profession's attempt to implement this most significant objective of industrial arts. Also, due to the limitation of time, we have prepared an annotated bibliography of many of the practices identified through our search. This bibliography will reveal the breadth with which this phrase "to gain an understanding of industry" is interpreted.

Regardless of the variations in the concept of "industry and technology" exhibited by members of our profession, the decade of the '60's brought forth a renewed interest in the "interpretation of industry". In fact, the past decade was ushered in by the US Office of Education's Washington "Conference on Industrial Arts" held during June 1960. This conference accepted as one of its tasks the following question, "What objectives should be emphasized in industrial arts?" As a result of their deliberation, one of the four objectives which should receive priority was -- to develop in each student an insight and understanding of industry and its place in our culture.

At the close of the decade the "Guide for Improving Industrial Arts", published in 1968, adopted the following as one of its five objectives: Develop an Insight and Understanding of Industry and Its Place in our Culture.

Note the similarity. A review of the persons involved in these two pronouncements will reveal a different group of principals, which suggests that this objective is widely accepted.

The objective with which we are dealing -- "That of the interpretation of industry" -- has had its ups and downs as far as professional recognition is concerned; but I'm personally convinced that for the foreseeable future the battle for this objective has been won.

An increasing number of industrial arts teachers want to be associated or identified with this objective, and only the most tradition-bound would deny its relevance.

Interpreting industry and technology is not only the "in thing" of the moment, but I believe it is also the central concept of industrial arts -- although I must hasten to add that there is wide disagreement in the manner and degree to which this general objective is to be implemented.

The identification of content related to industry and technology. Most of this disagreement stems from an incomplete meeting of the minds with regard to the broad term "industry" and the even broader concept of technology. Webster tells us that industry is any branch of art, occupation or business which employs labor and capital and is a distinct branch of trade. It is made up of several categories: (1) power, (2) manufacturing, (3) construction, (4) transportation, (5) electronics, (6) research, (7) management and (8) services. This does not help us to limit the concept at all, but it does indicate to us that we must analyze this complex whole in order to arrive at some teachable content.

I'm practical, but assume for a moment that the task of analyzing this rather complex and variable segment of our culture can be done effectively; what then is the significant problem? Basically it is one of synthesizing and selecting the proper or at least the desired content. This task necessitates value judgments which nearly always result in some form of conflict between individuals and groups.

Our study of the profession's attempt to identify, select and classify the content of the discipline would reveal that several individuals and groups have made these value judgments and that there are some resulting conflicts, although I would suspect that each would claim to have made the most appropriate judgments.

Regardless of the analytical process used, we must face the reality that we can't teach everything; so a selection must be made, and our fundamental question becomes, "What content and experiences will provide our students with the proper interpretation and the desirable degree of understanding of the industrial and technological phase of our society?"

I do not propose to give you an absolute truth relative to this question; in fact, I seriously doubt that anyone at this time and stage in our profession's development can provide us with an absolute truth regardless of the eloquence of the presentation or the forcefulness of the argument. What I do want to accomplish is to indicate some of the answers which various individuals and groups in our profession are proposing to meet this quite challenging question.

Perhaps the most significant point is that during the 1960's the attention of the profession was directed toward industry and technology and its interpretation in the industrial arts program. The major curriculum projects, which were funded by grants totaling hundreds of thousands of dollars as well as activities carried out by individual teachers operating independently, focused attention on this central theme. Even though our preparation for this presentation involved the review of literature describing a number of major curriculum projects, we elected to focus most of our attention upon the activities of teachers functioning in small teams and as individuals. Since we are not discussing some of the major projects which have had a tremendous impact upon the profession and will continue to have such an impact, we would direct your attention to a new publication by Leslie Cochran, entitled Innovative Programs in Industrial Education.

Not only was it our judgment that we could not do justice to any one of the major projects, let alone all of them during such a short time period, but we also judged that the majority of teachers in attendance at this convention would have previously been informed about these projects, since they have been frequently cited in the professional literature, as our annotated bibliography will reveal. Our survey of the activities which industrial arts teachers have designed to assist youth in gaining a more appropriate interpretation of industry, reveals several categories of activities which we will attempt to highlight for you.

Approaches designed to interpret industry. Many of the approaches reported by teachers recognize that the organization of industrial enterprises is significant and that the organizational pattern is sufficiently uniform (at least in production industries) to permit generalization in the classroom. Likewise, most of the profession sees certain major functions performed by industrial organizations that are basic and sufficiently uniform to warrant our attention -- such functions as, (1) research, (2) design, (3) planning, (4) material selection, (5) processing, (6) inspection and (7) distribution. Of course, the amount of emphasis placed upon these functions varies considerably.

I. As might be expected, the traditional industrial arts programs continue to dominate the profession; however, there is a significant amount of evidence that these programs are being modified to provide youth with certain experiences which are designed to interpret one or more functions of industry. These traditional programs are characterized by laboratory activity, primarily of an individual project nature, of the "take home" variety. However, there are several ways in which these programs are being modified in an attempt to interpret industry more adequately:

(a) For example, many teachers focus attention upon the study of "significant" raw materials and basic production processes of industry. In this approach, textbook assignments, films, lectures and discussions are centered upon chosen topics related to industrial materials and processes. Shop activities are considered in terms of the achievement of other objectives in industrial arts, while the emphasis is placed on knowledge of and about industry rather than on direct laboratory experiences related to industry.

(b) Another point of view expressed by those who would continue the traditional approach is that individual project activity in and of itself typifies industry, since planning, tool and machine processes, assembly, finishing and the like are inherently involved, and, therefore, interpretation will be a concomitant outcome. Many would argue, however, that this interprets a handicraft economy and an industrial process of a previous era.

II. Perhaps the most significant departure from the traditional approach which seeks to better interpret industry is the mass production or volume manufacture approach. In this approach, it is assumed that volume manufacture is the dominant element of industry and that for industry and its supporting technology to be properly understood, students must have direct experiences with group planning of products and of production processes, the construction of jigs and fixtures and direct participation in production line operation. Quite obviously, there is a wide range of implementation of this approach, which varies from a rather completely teacher-dominated approach, with students engaging primarily in the production phases; to a scheme which is student-dominated (from the point of determining a product to be produced, through market analysis, and culminating with distribution and profit taking.)

III. A third approach which we have observed from our survey included those programs which focused rather specifically upon a limited number of industrial or technical functions rather than upon a broad-gauge view of industry and technology.

(a) Examples of this type of approach would be one in which the functions of industry become the dominant elements. Examples of this approach would be those programs which place emphasis on research and experimentation or upon materials testing.

Summation. Admittedly these categories of instructional approaches are somewhat arbitrary for purposes of our presentation, and there are many other programs which would represent some combination of these or even perhaps an entirely different direction. We believe that we have represented the main thrust.

Regardless of the approach one takes, it does reflect a certain concept of the term "industry". If you limit the concept to a concern for the industrial organization and some of the major functions, you might be able to interpret this concept equally well in a woodworking or metal working or some other type of specialized laboratory. However, if your conception of industry recognizes the interrelationship of materials in product design, the advantages and limitations of certain materials for various components, and the significance of raw material processing, then you perhaps would have a greater justification for a multiple-activity program.

Conclusion. Absolute interpretation is not possible. Perhaps the most practical procedure is to: utilize the eclectic approach (draw from the major curriculum projects), with personnel organization, films, field trips, and production lines. We must make our courses relevant to the problems facing us as a society. We must orient youth to change. And, because our interpretation is based upon our background of experience, we must emphasize breadth in order that concepts are fluid, not stereotyped.

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Introduction to man and technology

Robert D. Brown

In this program, we will be primarily concerned with two things: the nature of industrial arts and the importance, if any, of including studies of technology in industrial arts courses. Let me explain my inclusion of the words "if any" in this opening statement. Many of us are willing to assume that developing an understanding of technology should be one of the goals of an industrial arts curriculum, but research evidence on which to base such an assumption is singularly lacking. There is presently no evidence, of which I am aware, that a person who has had an introduction to technology is better equipped to live his life than one who has not. In fact, evidence of the significance of industrial arts itself is in rather short supply. We assume that industrial arts experiences are valuable to students, and we may assume that these experiences should include a study of technology; but we are greatly in need of evidence that supports both assumptions.

What is industrial arts? Sooner or later in his career, an industrial arts teacher becomes aware that his field of expertise is a multifaceted educational discipline, that it has a number of objectives, and that through meeting these objectives, he can make many unique contributions to the achievement of the goals of his school. The key word here is unique. Industrial arts is a valuable part of a school's program precisely to the extent that it makes important contributions that the other educational disciplines cannot make.

The teacher also becomes aware that the significant, attainable and measurable objectives of his field include the following:

(1) development of the ability to make skillful use of a variety of materials and pieces of equipment that are common to selected industries, vocations and professions.
(2) development of a fund of technical information concerning equipment, materials, processes and applications of scientific and mathematical principles.
(3) development of an understanding of the importance of safety and the habit of observing the best safety practices at all times.
(4) development of the ability to produce and interpret fundamental types of drawings.
(5) development of an interest in creative work and the ability to solve design problems.
(6) development of the ability to evaluate consumer products accurately with regard to excellence of design and workmanship.
(7) development of skill in maintaining consumer products.
(8) development of an interest in, and the ability to carry on, numerous creative pursuits that have values as leisure-time activities.
(9) development of an understanding of the workings of basic industries, particularly their design and productive functions.
(10) development of knowledge of the requirements of, and opportunities offered by, a variety of important vocations and professions.

(11) development of an understanding, on the part of each student, of his interests and abilities as they relate to specific occupations.

Finally, the teacher comes to understand that industrial arts can function effectively in four distinct phases of any school's program. They are general education, special education, prevocational education and preprofessional education.

General education can be defined as education that is needed by everyone, because it is instrumental in enabling each individual to understand his environment and to function successfully, in a nonvocational way, in that environment. As an example of this kind of education, health is a major goal of every school. Safety is an integral part of good health; and industrial arts, through developing the ability to work safely with many kinds of equipment and materials, can make a contribution that cannot be made by any other discipline.

Special education aims at meeting nonvocational needs of relatively small groups of students. Learnings are largely in the area of self-realization, since opportunities are created for students to pursue individual interests and develop special abilities. An advanced course in architectural drawing can do this for students who are keenly interested in residential design but not necessarily in architecture as a profession.

Prevocational education is designed to prepare students to profit from programs of vocational education undertaken at the senior high school and/or post-high school levels. For example, an industrial arts power mechanics course, by helping a student to assess accurately his own interests and abilities and to acquire a certain background of skills and knowledge, can do much to ensure his success in an automotive technician training program.

Preprofessional education provides career guidance and foundations for professional programs taken at the college level. As one example, industrial arts electronics courses, especially advanced courses, can be of immeasurable help to a student in deciding whether or not electrical engineering would be a suitable profession for him; and they can furnish the bases for success during his early college years.

It is apparent, then, that industrial arts is a multipurpose discipline with many objectives and that it is able to make substantial contributions in all major phases of elementary and secondary education. Moreover, it seems clear that the main thrust of industrial arts must be as a participant in achieving the commonly-accepted goals of education--health, command of fundamental processes, worthy home membership, vocation, civic education, worthy use of leisure, and ethical character. (1) Industrial arts cannot, must not, go its own way without regard to the goals of the school programs of which it is a part.

In a presentation in June, 1969, at Southern Illinois University, Dr. C. Thomas Olivo, Professor of Industrial Education, Temple University, made some interesting and accurate observations concerning the nature of industrial arts. He said, in part,

> Industrial arts is a broadly-conceived educational discipline within the total educational process and program. Industrial arts provides important learning experiences centered in broad occupational constellations which are selected as being representative of the technological society.
>
> Industrial arts education is a planned series of manipulative, creative, teaching-learning experiences using the tools, materials and processes of our industrial society. Parenthetically, in working with less-developed countries, one thing that is appreciated more and more as accounting for the level of technological supremacy in the United States is the fact that our young folk in childhood and later in adulthood have an understanding of tools, of materials and of processes.
>
> Our culture demands an outlet to an inner basic urge and drive within the youth in this nation to create, to build, to manipulate. Industrial arts programs uniquely satisfy this demand.
>
> ...it provides the discipline of the work place, it provides teamwork, it provides precision at the level of the learner. (2)

This brings us to the second pertinent question: what is technology, and what role should it play in the industrial arts curriculum? An engineer or engineering educator might answer simply that technology is engineering. Traditionally, this is probably an appropriate answer, since many of the nation's engineering schools have been, and are, called institutes of technology. Hudson Moore, Jr., an engineer and a Distinguished

Engineering Alumnus Award holder of the University of Colorado, expressed this idea when he said, "Ideas underlying the technology of the future are abstruse; they are highly mathematical. To comprehend them, and to manipulate with intelligence the technology born of them, we require men of exceptionally advanced education in substantial numbers. Command of science and technology requires education not only to the doctor's degree, but far beyond." (3)

But a broader view of technology, and one that has gained increasingly wider acceptance in recent years, holds that there are many kinds of technologies and that a given technology consists of a body of knowledge, skills, equipment and materials that, collectively, give man mastery over a certain portion of his existence. They enable him to find solutions to problems that he considers essential to his well-being. Defined in this way, technology includes engineering; but it also includes aesthetic design, manufacturing expertise and other areas of productive human activity.

Early in its development, industrial arts was committed, through its stated objectives, to teaching students to understand industry. Industry is, manifestly, a more inclusive term than technology, since industry embodies economic, political, marketing, social, moral and ecological considerations that are not normally considered to be parts of technology. However, these aspects of industry, if they are important to students, can doubtless be taught more effectively in disciplines other than industrial arts; therefore, it may be entirely appropriate for industrial arts, at this stage of its development, to be more concerned with specific technologies than with industry in general.

Industrial arts, by and large, is required of boys at the junior high school level; and it is here that the field's largest and most representative clientele exists. But large doses of technology may not be appropriate at this level, especially if they are administered in a more-or-less academic way. If we know anything at all about junior high school boys, we know that they are physical activists and that they want to manipulate tools and materials with vigor. Teachers of other disciplines have also discovered this characteristic and have begun to modify their approaches accordingly.

Senior high school students are rarely required to take industrial arts; and at this level, where students' programs are full and the emphasis is so heavily on preparation for college, most students do not elect industrial arts courses. Those who do usually take one or two courses and seldom take as many as three courses. Moreover, high school industrial arts classes do not often enroll many of the most capable students.

What all of this means is that relatively few high school students will be available in the foreseeable future to learn about technologies from industrial arts teachers. It also suggests that most who will take industrial arts courses probably cannot, for lack of time, be immersed very deeply in any one technology and that the capabilities of most industrial arts students will make highly technical studies neither possible nor desirable.

I do not intentionally paint a bleak picture. In fact, the opportunities for industrial arts to grow and prosper seem unusually bright, as we enter the 1970s. However, we must be realistic about our expected clientele, which I have attempted to characterize. We must find ways to work effectively with the students we will get. They will by no means be all pre-engineering students, nor should they be.

As we contemplate the future of industrial arts, the important questions relating to its concern with technology would seem to be these:

(1) Do students who have developed understandings of one or more technologies really live more effectively than those who never possess such understandings?

(2) Is industrial arts being urged by its major constituencies--students, parents, industrial arts teachers at the junior and senior high school levels, school control and administrative agencies, and the general public--to view the development of knowledge of certain technologies as an important objective?

(3) What responsibility should industrial arts assume for acquainting students with technologies?

(4) What contributions to the generally-accepted goals of elementary and secondary education can studies of technologies make?

(5) What knowledge of what technologies can be imparted to the kinds of students who will enroll in industrial arts classes?

(6) How can studies of technologies be conducted so that they will be both appropriate to the needs of students and in keeping with industrial arts' commitment to make other significant contributions to students' education?

We are literally awash in opinion concerning these questions but, at the same time, urgently in need of facts which only research can supply.

FOOTNOTES

(1) US Bureau of Education, Cardinal Principles of Secondary Education, Bulletin No. 35, 1918, p. 11.

(2) C. Thomas Olivo, "Challenges to Vocational Educators in the Total Educational Program," Occupational Education Quarterly, Southern Illinois University, Volume I, No. 3 (Fall, 1969), 2-3.

(3) Moore, Hudson, Jr., "Engineering Academics and Industry," Graphic Science (October, 1969), 16.

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classroom teachers

What are the real problems for today's classroom (laboratory) teacher?

Joseph C. Heuer

Instruction. The instructor faces a real problem in making instruction meaningful and relevant to students in view of present-day problems of war, population explosion, social injustice, environmental pollution, breakdown of law and order, and deterioration of cities; especially since most of our subject area of industry and technology is establishment-oriented and contributes to the above problems through its individual and corporate profit goals.

Curriculum. The main problem each teacher faces in curriculum is finding the proper balance between fundamental skills and modern technological skills. What should be dropped from the curriculum in order to make room for some of the logarithmic increases of new industrial processes taking place in our complex technological society? In short, what to teach and what to exclude?

Students. Industrial education students can be characterized most often as underachievers. In our advanced education-minded society, these students either select for themselves, or in some cases are directed to, industrial education because they lack the desire or ability to succeed in the very subjects which they need most to achieve in industrial education. Thus every industrial education teacher faces the daily frustration of trying to help these weak students succeed in a subject area that requires for real success a strong background in academic subject knowledge such as math, science, English and art.

Facilities. Industry has progressed from handcrafts to power tools to automation to cybernation. Each progression has required a larger capital investment by industry for facilities. School, being a non-profit institution, has thus been forced to fall farther and farther behind in providing comparable industrial facilities for its students' instruction. Which facility is better for achieving the goals of industrial education, the general shop or the unit shop?

Administrative. While each teacher has many administrative problems, such as obtaining secretarial help, grading, filling out reports, rewriting courses of study and lesson plans, ordering supplies and studying guidance and counseling records, I feel that his main administrative problem lies in helping the school administration to understand all the problems of industrial education and to reach the correct and best crucial decisions about the future of industrial education in public schools. The shortage of teachers, the increasing cost per pupil in industrial education, as compared to other subject areas, the indecisiveness of industrial education about itself, and the lack of immediate concrete results in the form of occupational success of past students are factors causing the central administration to look closely and critically at industrial education.

Mr. Heuer teaches at Crown Point (Indiana) High School.

What are the real problems for today's classroom (laboratory) teacher?

George F. Von Spreckelsen

What is the common element of the major problems of today's industrial arts teacher? Is it money? Is it the students? Or is it having the laboratory in the basement or tacked onto the end of the school wing? The answer is more basic – that of attitude. It is the attitude towards industrial arts held by many educators, administrators, those involved in the creation of instructional materials, and our own colleagues that fosters and promotes many of our existing problems. The influence of their attitude can be felt daily upon the problems of instruction, curriculum, the students, facilities and administration of industrial arts.

Instruction. Instructional materials centers and school libraries contain an inadequate number of up-to-date broad-coverage industrial arts materials. It is true that in the past materials may have been in short supply on the market. That is less true today. Some problem exists in getting the industrial arts teacher to take time to make selection of supplemental materials. The larger problem of funds allocated for industrial arts materials is still prevalent. The advent of "Sputnik" spurred large expenditures for science. Today the social sciences are commanding a major portion of materials funding. Considering the information explosion in technology, the "cultural lag" in purchased industrial arts materials is accelerating.

Suppliers of industrial arts materials do us no favor when they exclude areas of our programs. A classic example of this occurred when a major "overhead" transparency manufacturer asked an industrial arts teacher if he wasn't interested in his wares. The teacher replied that the supplier was in the graphic arts business and yet had no materials for graphic arts. The supplier acknowledged that this was true.

Further difficulty is encountered by the teacher when he finds his classes are scheduled for the convenience of the student and the school without regard for instruction. Some classes are scheduled with students of mixed grade levels and experience. Admittedly this could be advantageous in some classes, but only if the instructor is consulted and is prepared for the situation.

Curriculum. While many of the new curriculum efforts are exciting and most promising, no great change seems to be in practice in the industrial arts labs. In spite of the proverbial scapegoat, the administrator, many industrial arts teachers are not receptive to change. Their attitude and lack of cooperation greatly impede any initiation of a new approach. This is especially true when previous and current programs have not been supported with supplies and materials.

Students. We live in an industrial-technological society. We justify industrial arts in general education by that fact. We seek to provide everyone with an understanding of that society as well as of consumer education. Yet industrial arts teachers, as well as the administrator, exclude the girls from our laboratories. Surely their need for industrial arts is no less important than that of boys.

Facilities. The absence of flexibility, representative industrial equipment, supplies and processes is most frustrating. Boiled-down concepts and processes go only so far for a student until the "real" thing becomes abstract. Teaching gravure in graphic arts loses a great deal in the translation, when linoleum is the material supplied to the student.

Students and teachers find further difficulty when planning and audiovisual areas are not available to the laboratory. One might presume more students would elect industrial arts if they could expect more adequate facilities.

Administrative. Many administrators still appear not to regard industrial arts as general education. This perhaps is due to the hazy distinction between industrial arts and vocational education. Still, the cost of equipping the industrial arts program is the standard factor cited when endowment is small. On the other hand, industrial arts teachers can hardly accept the science department's receipt of thousands of dollars, while they still purchase nails, screws, lumber and the like out of their own pockets.

What is the answer to these attitudes that foster and promote problems for the industrial arts teacher? The answer is obvious - it is his attitude that must improve. He must believe that industrial arts is a valid part of general education. He must be receptive to change and willing to participate in seeking to improve industrial arts programs. His facility must be more than just a shop, it must be a laboratory for learning, open to boys and girls. Then we can begin to attack the problems of instruction, curriculum, the students, facilities, and the administration of industrial arts.

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A dialogue— industrial arts teachers-industrial arts administrators

Jack Dean Ford

There are some real problems of the teacher that concern me. Some of the major concerns deal with the area of curriculum.

I feel we need time to develop more meaningful experiences that place the students in the roles of industrial practices. Consequently, we bring or simulate the environment of industry into the classroom for the student to experience. In this way the student is introduced to what it is like and to how he might feel as a participant in that specific activity. Given a broad scope of realistic experiences, the student should have more information with which to analyze himself and make a more meaningful career choice.

Such instructional materials have been developed by various curriculum projects, but most of the emphasis has been focused at the junior high school student. So now there is a dire need for continued development at the high school and elementary school level.

It is important that industry be involved in developing these materials. This presents many problems with respect to identifying people who can help, and in interpreting the technical story industry has to tell in a form that is acceptable and meaningful to youth.

The developed instructional materials are important tools for the teacher. They provide a basic program from which to build. Instead of channeling the teacher, they could free him to concentrate more on his teaching skills and give him the opportunity to create more meaningful activities for his particular group of students. Good instructional materials can help the teacher who has problems with disorganization and poor planning. If more of a guide or structure can be put into the hands of the teacher who has a problem planning and identifying what he is going to teach, he can present a more meaningful and organized experience for his students. Consequently, the lessons presented are more acceptable to the students, and this improves discipline and class organization, which will raise student interest in taking industrial arts courses.

I feel one problem in instruction and curriculum is to adapt more materials for individualized instruction. The industrial arts teacher has contributed to this form of instruction by haying students work on projects that are equal to or a challenge to the student's achievement level.

There are packaged materials on the market that are programmed and that provide the opportunity for the students to move at their own pace. We need to investigate how such materials can be adapted in all our programs and involve teachers in developing them. This lends itself to the problem of the need for more in-service and pre-service training of teachers. There is a need for developing instructional objectives and activities that will provide meaningful experiences that represent industrial technology in today's industrial world.

Along with the developing of skills in identifying and writing instructional materials, teachers need to become more informed about how to make the best use of instructional media, such as sound filmstrips, listening devices, single-concept film loops and overhead transparencies, in their presentations. There is also a wealth of instructional materials provided by industry that needs to be secured and made available for teachers' use. Therefore, the time to identify the most effective use of these media and skill in presenting them is another problem of organization and in-service training.

In order to accommodate a variety of activities or to implement different programs, facilities must be flexible. By flexible, we mean that machines and work stations need to be installed so they can be moved from one position to another. This means that utilities and electrical service must be available in many areas of the room. This does not need to present a major problem when planning future facilities, but in existing facilities where all equipment was installed with rigid conduit and set permanently in place, it is sometimes difficult to be flexible. It is often easier for the teacher to leave the facility as it is and continue teaching the same program and activities than it is to analyze the situation and adjust where he can. The problem of planning and making provisions for change in facilities to implement change in instructional programs can be frustrating and time-consuming for the teacher.

The problem of maintenance and housekeeping is one that confronts us constantly. In most larger school systems, maintenance is done by a special employee who is summoned through a work order which is initiated by the teacher. This presents the problem of having a machine out of order while waiting for the work order to be filled. Smaller school systems, who do not have the provisions for a maintenance man, view this as a part of the teaching assignment, so, in either case, preventive maintenance programs are a necessary part of the industrial arts teacher's training.

Special programs with varied activities present a problem for teachers in buying materials and equipment with which they have not previously dealt. This means finding the proper specification of the product and identifying a vendor from which to buy it. This can be very time-consuming for the teacher.

I feel we have a problem in some localities as to where the industrial arts teacher stands in the eyes of administration. Does the high school administrator view his industrial arts program as a strong segment of general education for the students to become well-informed citizens, or does he feel that this is a program specifically to train students to enter employment? Keeping the administrator informed as to the proper objectives of industrial arts is a problem that most teachers encounter.

In summarizing some of the real problems that concern everyday industrial arts teachers, I would emphasize curriculum development, instructional methods, identifying various means of adapting facilities to make them more flexible, and for the industrial arts teacher to identify himself as an equal member of the instructional team that is educating children, and to become an active member of that team.

Mr. Ford is associated with the Cincinnati (Ohio) Public Schools.

Industrial arts teachers-industrial arts administrators: a dialogue

O. Frank Haynes

In my discussion today you will notice my concerns seem to shift from those of a teacher to those of an administrator, and back again to a teacher. This seems logical, because what concerns the teacher should concern the industrial arts administrator, and our discussion will prove to sustain this belief.

With your permission, I would like to share with you some of my concerns in (1) instruction, (2) curriculum, (3) students, (4) facilities, (5) administration. Although these categories overlap, an expression of each seems to be in order.

Instruction. In the area of instruction a vital concern is that of keeping abreast of instructional materials and methods which are proving to be worthwhile. How does a teacher review and evaluate the volumes which are being written on the various industrial arts programs in progress at the present time?

How does a teacher keep abreast of the new audio-visual materials and hardware being developed?

How does a teacher keep his resource material up-to-date?

What kinds of instructional methodology challenge students to do independent study?

How can a teacher feel comfortable in utilizing newer methodology of instruction when he has not been taught and encouraged to use them?

These are a few of the concerns in the area of instruction.

Curriculum. Curriculum poses a real concern to the good industrial arts teacher, regardless of what grade level he teaches. The curriculum must be adaptable to the wide range of interests and abilities of the students. It must be evaluated and revised constantly to keep it up-to-date. It must be relevant to the learner and the society in which he must live. It must reflect industry today and tomorrow to satisfy our industrial arts objectives. Teachers are concerned with keeping the curriculum updated. Teachers are forced to analyze curriculum to keep a current "live" industrial arts program, and teachers are concerned that time is not available to do constructive curriculum work.

Students. In our day-to-day teaching, "students" is the prevailing concern. How do you motivate this student to do something constructive? How do you get John interested in a constructive activity? How can I teach Charles to be more safety-conscious? How can I give a written test to Jack, a non-reader? How can I get a class of 27 or 30 students involved in constructive activities with 22 work stations? How can I utilize other departments within the school? How can I make better use of our community resource people? How can I design a program which will challenge the more capable and at the same time be a worthwhile program for the average and below-average student?

These are concerns of the classroom teacher. These are concerns for the administrator. You will notice that I did not supply the answers.

Facilities. While attending a recent Industrial Arts Supervisors Conference at Indiana State University, a group of industrial arts supervisors were challenged to design a curriculum and facilities for the emerging middle-school concept of grade grouping. The dominant factor in designing facilities seemed to be flexibility. I believe the industrial arts facilities in the future will be designed for maximum flexibility, and the space can be arranged and rearranged to fit the curriculum and program, rather than the curriculum fitting the facility. This, however, does not solve the problem of the numerous facilities which remain in a fixed arrangement throughout the life of the building. Construction and remodeling are expensive undertakings and, as we are all aware, require the expenditure of tax dollars. I believe it is the responsibility of everyone engaged in industrial arts education to sell our program to the pupils, parents, teachers, administration and the community. Make the best program we possibly can in our existing facilities, and, when the time comes for remodeling or construction, we will be in a much better position for improved facilities.

Administration. As I stated in the beginning of this presentation, I find myself switching from the role of the administrator to that of a teacher and back again to an administrator. Teachers wonder why this isn't done, or this takes so long, or why I have to wait until the next budget year. Administrators are concerned with budget, equipment, scheduling, teacher morale, student load and an adequate supply of well-trained teachers. Is there a better way for an understanding of each other's problems? Every administrator wants the best program, in the best facility, with the best students, the smallest class size, and unlimited funds for materials and equipment. Every teacher shares these concerns. The problem is communication and understanding of each other's problems and cooperative solutions to these problems.

Solutions are not directed by the administration nor demanded by the teacher. The better programs exist where there is harmony between the administration, the teacher and the pupil.

I have tried to outline some of the concerns of the administrator and the teacher. In essence these concerns are one and the same. Both parties are concerned with instruction, curriculum, students, facilities and a harmonious relationship between the administrator and the teacher. It is my hope that these remarks will foster that better understanding, which must exist for a truly outstanding industrial arts program.

Mr. Haynes is with the Indianapolis (Indiana) Public Schools.

The implementation of differentiated staffing

John P. Takis

First, what is differentiated staffing? Second, who is advocating it and where? Third, why is it being advocated and what are its implications for industrial education? And, fourth, where can you get to know more about it?

Although a variety of models exist, basically differentiated staffing is a hierarchy of professional and non-professional personnel who are assigned to roles in terms of training, interests, ability, career goals and difficulty of tasks to be performed. Teachers and aides are organized in order to take advantage of their respective competencies to plan, instruct and evaluate students in one or more subject areas. Differentiated staffing can provide for large-group instruction, small-group instruction and individualized instruction. Differentiated staffing can also make use of, and is concomitant with, flexible modular scheduling, educational technology and other innovative methods and aids.

The hierarchy can be structured in any number of ways to suit the needs of various situations. A list of the different job classifications might include: The Master Teacher, Senior Teacher, Staff Teacher, Associate Teacher, Intern, Student Teacher, Paraprofessional, Teacher Aide and Clerk.

As one can see, differentiated staffing provides meaningful career ladders for teachers. It allows teachers to advance and still remain in the classroom.

Secondly, who is advocating differentiated staffing and where? One of the earliest and foremost leaders, and the one who could be considered most responsible for its present state of acceptance, is Dr. Dwight W. Allen, Dean of Education at the University of Massachusetts. Since much of his preliminary work was at Stanford University, it is natural that early acceptance came in California. Differentiated staffing has been implemented in Temple City, California, under the leadership of Fenwick English; in Fountain

Valley, California, under Superintendent Edward W. Beaubier; and in Kansas City, Missouri, under Assistant Superintendent Donald Hair. It has also been implemented in several elementary schools in the Far West.

Other prominent leaders and advocates are: Ronald Corwin, Ohio State; Roy Edelfelt, NEA; Charles Olson, Lawrence High School, Kansas; Alvin Lierheimer, New York State Education Department; and Joseph Arnold, Ohio State University; and many others too numerous to mention at this time.

Differentiated staffing has also been advocated by both the National Education Association and the American Federation of Teachers, each of them cautioning that the success of such a system will depend upon its development by the teachers themselves and involvement in its planning. The prognosis for this is bright, since differentiated staffing embraces this notion. Differentiated staffing is characterized by its decentralized decision-making, rejecting the concept of central authority as a method of controlling people.

In addition to the professional organizational support, differentiated staffing is being advocated and supported by the education departments of some states. Among those of which I am aware are Massachusetts, Vermont and Utah.

My third point--Why is differentiated staffing emerging as an answer to some of today's educational problems? Well, differentiated staffing recognizes that teachers are not all alike, even though in most of today's schools, teachers are treated as though they are interchangeable parts. The expert teacher, the incompetent and the new teacher are all charged with similar responsibilities, and these basic responsibilities remain the same for their entire teaching career. Therefore, ambitious teachers have nowhere to advance except into administration, either in education or in industry, and away from the classroom.

Differentiated staffing gets at the problems of education by (1) providing a structure wherein higher pay, recognition and advancement are given according to well-defined teaching and supportive roles and accompanying responsibilities, by (2) providing a structure wherein innovative methods, large-group, small-group and individualized instruction and other means of optimizing instruction, can be tailored to meet community, school and student needs, and by (3) more clearly defining teaching, non-teaching and supervisory responsibilities, whereby differentiated staffing can facilitate more accurate hiring of people to perform duties commensurate with their skills and abilities.

Finally, the implication of differentiated staffing should be apparent to all of us. The industrial educator is better equipped with leadership traits and the ability to command large salaries outside of education than most other teachers. It is in industrial education where there is still a great shortage of qualified instructors. Therefore, we need to keep our industrial education teachers in the classroom.

The emergence of many plans to interpret industry at the industrial arts level, such as the Galaxy Plan, the IACP, the American Industry Plan, the Alberta Plan and others, seems to be tailor-made for differentiated staffing. Such plans need the versatility and flexibility that differentiated staffing can offer.

At this point, let me say that time just does not permit me to elaborate further. Please let me urge you to become more aware of what is happening in differentiated staffing.

Mr. Takis teaches at Ferndale High School, Ferndale, Michigan.

Leadership and direction for providing local in-service programs

Robert O. Beauter

As an advocate of flexibility in teaching, I believe that the new trends in industrial arts can truly bring industry into our programs. Some of the old ways are, in my estimation, still useful; and I do not advocate dispensing with them completely, but using them as a supplement to other methods.

As a supervisor, the first problem was to convince myself of their value. I had listened to two excellent presentations on the subject by people involved in the programs, and, frankly, I still wasn't quite convinced.

When the opportunity came to participate in a course featuring "New Trends in Industrial Arts", I enrolled because of the number of my instructors who were taking the course. I felt that the least I should be able to do was discuss these methods with them in a knowledgeable manner.

Many of these instructors took the course for college or increment credit, and I believe many were as skeptical as I was.

Discussion of the topic beforehand evoked such remarks as, "Thank goodness I am retiring in a couple of years."

As it turned out, no one this near retirement participated in the program, and, if they had, it is doubtful they would change after so many years.

Taking a course as we did in "New Trends in Industrial Arts" was a worthwhile experience from several aspects. I say this because of the fellowship and sharing that occurred.

The type of cooperation that went on can be indicated in the case of the teacher who had as his topic, under transportation, "The Bicycle". He was constructing a model and reporting on the "high wheeler".

Another teacher in the class spotted a "high wheeler" outside a bicycle shop as he was driving past. As soon as he arrived home, he called the teacher who was working on this project. This teacher then went to study the "high wheeler".

During the seminars, no matter what the topic, someone in the group would have a suggestion as to materials or methods which would facilitate the project. Often the contribution was in the form of a name and phone number of a person who could offer advice on the subject.

This spirit of sharing developed a camaraderie that turned into enthusiasm for the subject.

Each person left the class feeling that at any future date he could call on anyone else in the class, or better still, refer his own students to them.

The spirit instilled clearly indicated that each of these people would gladly serve as a resource person for boys, even of other school systems.

It is to be hoped that something of the same spirit would be excited by students in this program. If such were the case, the atmosphere in the shop would be highly conducive to learning.

As a student in the class, you would be assured of concluding the course with a well-packed notebook of valuable information in the form of handouts from your classmates.

Non-participants in the class were definitely influenced when they saw these methods put to work in their schools by the ones who had participated. This was evident in the fact that there have already been nineteen requests for participation in the next class, from my school system alone.

You have got to participate in and be exposed first-hand to these methods in order to appreciate what you can do with them.

The main problem confronting us has been the physical facilities and, in all probability, it will be yours, too.

Norfolk, for example, consists of sixteen secondary schools, varying from elderly inner-city schools, to air-conditioned suburban schools. Five of these are senior high schools, and eleven are junior high schools.

Most of the shops are general unit shops, with the average junior high having four, and the senior high four plus drafting. In most junior high schools, drafting is a part of graphic arts.

Norfolk facilities consist of the following combinations:

1 general shop including drafting
2 general shops plus drafting
1 wood/metal - drafting, electricity/graphics
1 wood - metal - drafting
1 wood - metal - drafting - graphic arts
1 wood - metal - drafting - graphic arts - electricity (1 room, 5 teachers)
4 wood - metal - electricity - graphic arts/drafting

With the exception of two senior high schools which have automotive shops and one that has no electricity, the composition is wood, metal, electricity, graphic arts and drafting.

I would say that this is quite typical of older cities of any size.

Needless to say, changes in such physical lay-outs and equipment would be financially impossible.

The main problem would seem to be how to adapt existing facilities to these new approaches.

These modern trends are still so new to us that we have not had the opportunity to explore all the possibilities for solving the problems with which we are confronted.

Some areas create virtually no problem. This is very true of the wood and metal areas.

Electricity does not offer too many obstacles, as witness the fact that two of the teachers most successful with these methods are in this area.

Drafting would seem to have some handicaps, but not for a versatile teacher.

Design of a major project, such as a small shopping center, with each student handling different aspects as in an architectural firm, is one approach.

Reports could cover such areas as financing, progress, materials, equipment, specifications and test performed.

The opportunities to bring in guest speakers are unlimited in this area.

Other classes might work on the redesign of existing man-made items.

Graphic arts would seem to have its greatest opportunity in mass production, and, with the cooperation of the rest of the department, other aspects can be more fully explored.

Concepts other than those we have concentrated on would seem to hold more possibilities for the graphic arts and should be utilized in the other areas as well.

We still have much work to do, and, if we remain flexible and apply the best of the various approaches, we will be able to find a modern approach that can be utilized in each area of our existing facilities.

We are always talking about getting involved with the other areas of instruction, but seldom is anything done about it. No greater opportunity ever presented itself than these approaches to industrial arts for accomplishing that objective.

The most curious people in the world are children, especially at the elementary level and early junior high. Then this curiosity seems to disappear. Could we be killing it with programs that will not allow them to satisfy their curiosity because of stereotyped programs that tell them what they must learn?

Natural curiosity is one of the greatest motivating factors in education, and the trends which we are discussing here can serve as a vehicle for this curiosity.

A couple of years ago, one of my instructors came to me with a plan for updating our curriculum. It was well-planned and included the utilization of people from all areas of instruction. College, state department, local personnel in charge of instruction, and teachers were to be included.

The instructor did most of the work, with me adding an official endorsement where it was proper. It was a successful venture.

What has this got to do with the topic? Only that if you are convinced as a teacher, then sell your supervisor using the same technique, being sure that the plan is thorough and professional.

I doubt that self-instruction in these areas would be adequate. What is needed is a good in-service program.

Mr. Beauter is with the Norfolk (Virginia) Public Schools.

Implementing the new curriculum patterns into laboratory practice

Mark Delp

I was recently asked for my own honest opinion on what is now being termed the "New Industrial Arts". That seemed simple enough. I said, "I am for it." That question led to the one that was really hard to answer. "Why are you for it?" I was asked. This was a different question and could not be answered in one sentence. There are as many reasons as there are changes going on in industry today. In other words, it would be impossible to enumerate them all. But this is not a "cop-out", as my students would call it, because I do intend to try to enumerate some of them for you as I show you what we are trying to do toward implementing the "New Industrial Arts" in Prince William County, Virginia.

After being on a panel of speakers and giving a slide presentation on what we were doing at Gar-Field High School and in Prince William County to the Virginia Industrial Arts Association last summer, the other members of the panel and I were subjected to a question-and-answer period. One of the first questions was directed to me by a very dedicated but puzzled teacher. He asked me if I wasn't for change just for change's sake. I could not help but reply that I was.

And I will repeat that I am still for change for change's sake. The world around us is changing every day, and each day more rapidly than the last. It is for the sake of this change that we must change or become extinct as a profession. If we are to teach contemporary industry, we must change as it changes and in such a way so as to change continually.

The traditional industrial arts of making bookends and sugar scoops was excellent when that was the stage where industry was. The industrial need for craftsmen to make complete items from beginning to end is nearly non-existent today, as far as large industry is concerned. There is, however, a definite need for people who understand industry and how it operates; for people who can determine where they might fit into this industrially-oriented society of ours to its and their best advantage. I believe the New Industrial Arts can bring this about to a much greater degree than the traditionally-oriented program.

Teaching, however much we would like to disavow it, is like many other things. It is a matter of percentages. You are never going to get to everybody all the time, but when you stop hunting ways to get to more people more beneficially, you are stagnant and of very limited use to your students. To be of benefit today, we must teach contemporary industry in an effective way.

When do students learn? They learn when they are interested. They are interested when THEY think what they are learning is relevant and when teachers aren't trying to talk it into them. Students learn by doing.

How then does this "New Industrial Arts" accomplish this; whereas, a traditional program may fail, and what is this "New Industrial Arts"?

In Prince William County, Virginia, industrial arts means teaching industry employing a number of different methodologies, including group project studies, the unit method, materials and research, line production and the individual project. No, we are not doing away with the individual project. It still has a place, but we do not feel it should be used as the only teaching method. There is more to industry than just materials and processes — a lot more.

On the high school level, the following courses are available in Prince William County, with a few exceptions: manufacturing, construction, communications, electronics, drafting and graphic arts. Materials and research are available in one high school already and will be available in my high school next year.

Let's take a look at some slides that should depict our program more accurately than I could explain it.

(Slide presentation and explanation of program)

Do these methods sound like proper vehicles to teach contemporary industry in an effective way? I believe they do. They are not the only effective ways I am sure, and more ways are likely to be found. Likewise, all methods won't work equally well with all teachers, nor with all students, but the more tools we have at hand, the better the job we are capable of doing and are likely to do.

As with anything that is going to work, you must believe in what you are doing. I believe in this "New Industrial Arts". I believe it will work for my students. If it works for them, it has worked for me.

Mr. Delp teaches at Gar-Field High School, Woodbridge, Virginia.

A classroom teacher in the role of a teacher educator

Michael R. Morton

(The beginning of the presentation is a slide-tape narrated series of the historical approach as carried out at Washington Irving Intermediate School in Fairfax County, Virginia.)

Today's families move on the average of once every five years, written research doubles every eight to ten years, and old jobs are done away with and new ones created at an increasing rate of speed. The general industrial arts laboratory was developed to broaden students' experience and understanding of industry and technology by studying their organizations, material, occupation, processes and products, along with the problems and benefits resulting from this, our industrial society.

During the history of industrial arts, the demonstration has been the major means of instruction, with the teacher the major source of information to be learned and the project the primary measuring stick for evaluation. Today, however, almost every person in America is dependent on our industrial base and needs to understand more about industrialization than learning the parts of a half-dozen machines used in a home workshop. Therefore, what concepts and mental skills a student takes from our class are more important than the project he holds in his hand. All too often in our past, the only instruction from the teacher was in the form of material to be memorized, such as lists of machine parts, safety rules and demonstration steps geared to projects pre-conceived by the instructor.

This is fine for project instruction, but today projects and the few skills developed in their making are not enough in themselves.

Twenty years from now I will not be proud of myself or of industrial arts if men are still pointing to the lamp or table in their house and saying, "That's what I learned in industrial arts." I hope what the student associates with industrial arts will not be as tangible or as easily-destroyed as a lamp. We need to add new tools of instruction for teaching concepts, for developing research skills, for improving inquiry methods, for developing individual instruction techniques, and for showing students that all subjects are needed and integrated together in "life". I like to think of a teacher as having a "tool box" full of instructional methods of which he is skilled in the use and can recognize when to use, just as the professional golfer looks over the lie of his ball and selects which club to use. We must have more than one club in our repertoire than the project method. We professional educators should have a proficient command of many teaching methods, as the professional golfer has command of the clubs in his golf bag. Examples of teaching methods are the unit historical, the group, the contemporary unit, line production, and research and development. Diagnosing when to use which technique can be compared to a doctor diagnosing the correct therapy for a patient. Where a carpeter used nails, glue, screws and paints to construct his work, the professional educator should call on 16mm films, single-concept films, transparencies, educational TV, magazines, books, guest speakers, libraries, museums, computers, and an endless list of resources limited only by the imagination.

These teaching methods and tools are not things which can be learned and used professionally by hearing about them or by seeing them demonstrated, just as the professional golfer does not learn by listening and seeing alone. Involvement is the most effective method of instruction and is a must for educators to use in this age of accountability.

The teacher must not only be shown and told how a teaching approach should be done, but, most importantly, he must experience the problems, techniques, frustrations and joys of learning to teach by doing.

In Virginia the complexion of industrial arts is changing, under the leadership of State Industrial Arts Supervisors Tom Hughes and Marshall Tetterton. Virginia State College is offering a graduate course which instructs industrial arts teachers in how to implement new techniques in industrial arts instruction. The tuition is paid for by the State. It is hoped that this program will eventually reach all of the State's industrial arts teachers. The program follows closely one begun in Fairfax County, Virginia, where, under the leadership of Lou Godla and George Litman, Fairfax County paid the teacher's tuition to travel to the University of Maryland and take a similar course.

Beginning this past fall, the practicum course was given in four areas of Virginia. It was taught by teachers from Fairfax County who had taken the University of Maryland course and developed skills in implementing the Maryland program. This spring the course is being taught in five locations around the State.

Our goal is to instruct all of our present teaching force in new methods of instruction and not to limit our outlook to just one program that has proven itself successful but to broaden our base to other instructional techniques as well. I hope that in the near future most of the new industrial arts teachers hired in the Old Dominion will be trained in the application of these tools of instructions. However, one course is not the complete answer to our problem of better meeting the needs of all Virginia's students for our industrial and technological age.

Our new instructional program follows closely the Maryland Plan; however, we do not want to limit our thinking to one program. We feel that the more teaching techniques in which our teachers are experienced, the better job they will do in meeting the individual needs of Virginia's students. A basic stumbling block, however, is college industrial arts leaders, who proclaim a new program for industrial arts but do not practice what they preach in their own classrooms.

Mr. Morton teaches at West Springfield High School, Springfield, Virginia.

Effective teaching—how to do it

Robert M. Wilson

The most effective teaching, regardless of field, seems to reflect a theory or model which is well understood by the teacher. Ineffective teaching quite often seems aimless and without a central theme. I would like to start this session by presenting a model for teaching which might help teachers in their planning.

This model, originally presented by Ruth Strang(1), is a model which focuses upon the learner.

$$\begin{tikzcd}
O \arrow[r] & S \arrow[r] & R \arrow[r] & T \arrow[r] & P \arrow[llll, bend left]
\end{tikzcd}$$

O = the organism, the student. The teaching always starts with one or more O's.

S = The teaching situation in which the student finds himself. S's usually are controlled entirely by the teacher.

R = the student's response to the teaching situation.

T = the trace or impression that the response leaves on the nervous system.

P = the perceptions which the student develops from repeated experiences.

And so the cycle continues, always starting with a learner who brings to his learning situations numerous perceptions which have been previously developed.

To this model I'd like to raise several questions and attempt some answers.

(1) From what source does motivation for learning come? Obviously from previous perceptions. If school and teachers are perceived as unfair and dull, then motivation will be difficult. If previously-developed perceptions reflect feelings against learning, the teacher will need to develop activities to modify those perceptions before serious learning can take place.

(2) Who is responsible if an "S" is not appropriate? Only the person who selects the "S". Although the student is often blamed for not being able to meet the teaching situation, this model suggests that it is the teacher who must develop a situation to which the student can respond.

(3) What if the student does not respond? He always responds. Many times, however, he does not respond as we would wish. However, he responds in reference to his previous perceptions. The teacher's task is to know what his responses are and to be ready to restructure the lesson before inappropriate responses become firmly-fixed perceptions.

(4) What happens when responses trigger conflicting traces? Students seem to be able to adapt to conflicting traces. However, if responses continue to generate conflict, the resulting traces will generate confused perceptions.

(5) What do we do about bad perceptions? Perceptions are always true, and should never be considered bad. They are all that they can be. So we must start by accepting them as true.

It now seems appropriate to cite several specific examples of how a teacher can use a model such as this one to guide his teaching.

(1) Accept and challenge. Since learning starts with the student, the teacher must accept that student as a learner who has learned many things prior to coming into a given learning situation. To attack, criticize or challenge a learner about his previously-developed perceptions does not build a climate for the learner. In our work with troubled learners, we spend large amounts of time finding areas of strengths within which the learner can demonstrate how well he can respond. Once he starts to feel comfortable with us and with himself, we find that he accepts challenge and tends to become an aggressive learner.

(2) Teach before testing. Teachers must ascertain what the student has learned *before subjecting him* to test situations. Acceptance of this point will require the teacher to obtain feedback which is not subjected to marking or grading. Such feedback serves to tell the teacher whether the teaching situation was appropriate. Could the student respond appropriately? Where did the lesson go wrong? Re-teaching and restructuring of lessons which elicit inappropriate responses are then needed.

(3) Remove frustrating blocks to learning. We attempted to develop a learning situation with 31 seventh-grade students who could not read well enough to use their texts.(2) By removing the texts as a block to learning, we found that these students could and did learn. Instruction was presented in the form of discussions, experiments, films, pictures, etc. As the students talked about what they had learned, their language was recorded. By reproducing transcripts of their talk, the students now had written material to which they could react. They read it and understood it. The students developed books for each of their subject areas – books which contained their language and their perceptions.

(4) Eliminate oppressive reactions to failures. Many teachers have been justifiably accused of reacting to the failures of their students with oppressive tactics - "Stay after school" - "Do three more pages" - "Why didn't you listen?" - "You fail" - "Flunk, flunk, flunk". Such reactions seem to reflect a lack of understanding among some teachers as to who is responsible for the student's learning. Our schools are full of children who are convinced that effort is not worthwhile and that failure is inevitable.

In conclusion, I urge all teachers to search for a model for teaching and adapt their teaching techniques to it. The particular model presented in this paper might or might not suit you, but it is important that you find one. Your students need a teacher who understands the theory which supports instructional techniques which are used to teach them.

FOOTNOTES

(1) Strang, Ruth, "The Reading Process and Its Ramifications", Invitational Address, 1965, International Reading Association, p. 70.

(2) Robert M. Wilson and Nancy Parkey, "A Modified Reading Program in a Middle School" Journal of Reading, March, 1970, pp. 447-52.

Suggested Readings

(1) Fader, Daniel N., Hooked on Books, 1966, Berkely Publishing Co., New York.
(2) George B. Leonard, Education and Ecstasy, 1968, Delacorte Press., 1968.
(3) Walter B. Waetjen and Robert R. Leeper (editors), Learning and Mental Health in the Schools, 1966, ASCD, Washington, DC.

Dr. Wilson is director of the Reading Center, University of Maryland, College Park.

A program for in-service teacher education in cast metals

Wilbert C. Bohnsack

I should like to share with you my experiences in a most successful cast metals in-service program.

Although not advice as such, I believe some aspects of our experiences in Milwaukee will be of interest to you. I believe many of you have been faced with problems similar to those we faced. Now I know you don't need more problems. Rather, I should like to alert you to a source of help of which you may be unaware. Although Milwaukee teachers have participated in the bi-annual foundry seminars conducted by the American Foundrymen's Society for the past 15 years, we did not get to work closely with officers of the local Wisconsin Chapter until 1966. The initial contact was in the form of a letter from the president of the local Wisconsin Chapter of the American Foundrymen's Society to the superintendent of schools in Milwaukee, expressing the Chapter's interest in extending foundry facilities at our technical high school.

As a result of this communication and subsequent meetings, a joint educational committee of the Milwaukee schools and the Wisconsin Chapter was established. The purpose of this committee was to develop a curriculum and recommend procedures that would contribute to a better cast metals program in the junior and senior high schools, as well as in the Boys' Technical High School.

The educational chairman and officers of the Wisconsin Chapter, as well as several chairmen of the Board, presidents and vice-presidents of local foundries, said, in effect, "Tell us what we can do to help in getting a better cast metals program in your technical and secondary schools." Well, when you get that kind of interest from an industry by having men in these positions offer their help, you would be very foolish not to take advantage of their technical skills and knowledge, as well as of their interest.

When someone asks you how they can help, you wonder how far they would be willing to go – and if they will help as they say they will, what would I want them to do? I told the officers of the local chapter that, as I saw it, the biggest problem was the lack of teachers with any training in the teaching of cast metals. And every teacher on the joint committee agreed with me. There were some other problems that deterred the teaching of foundry even though it was a part of the metalwork curriculum. But I believed these could be solved if we could give teachers sufficient realistic foundry experiences that would give them the confidence to go back to their individual schools and offer a cast metals program. Many of the teachers had regularly attended the 2-1/2-day foundry seminars, and some had received an exposure to cast metals in their college training, but too few really felt confident enough to offer it as the curriculum required. As a result, many tried it several times and gave up. The reason given by most teachers was, "I've never really done much work in it." Or, "I've heard talks and I've read about it, but I never really had a chance to do much in it." Or, "I've tried several times, but I can't seem to get results." In all fairness, I should say that there is, or was, very little reliable written material with which a teacher could help himself – just check your available texts and see if you would be able to make a mold from the directions or information given.

If my suggestion to teach the teachers jolted them, they didn't show it. These foundry owners and Chapter officers said, "If this is your problem as you see it, how can we proceed?

"1. What types of experiences do your teachers want?
"2. How much time do you think it will take?
"3. Where can we provide this first-hand experience that your teachers say they need?"

I said, "There is one more – what accrediting university or college will recognize this course for credit, so that those teachers enrolling in the course would receive some recognition of their interest and effort towards salary increments?"

Next an outline of the suggested course was prepared, and it was estimated that if we could get five full days of demonstrations together with actual shop work, added to whatever background some of them now had, we should go a long way toward giving the basic know-how – enough at least to give them the confidence to try it again. Once we had decided what we should do, the answers to the previous questions were not too difficult.

Fortunately, Milwaukee has a technical college with good foundry facilities and an enthusiastic and competent instructor. Through the efforts of Dr. Ruf (see following section) and the president of the Wisconsin Chapter, arrangements were made to offer the course at the Milwaukee Area Technical College during five days of the 1968 Christmas vacation. At a meeting of the Chapter officers, the proposal to sponsor such an in-service course was presented. No one objected. It was proposed that the Chapter not only underwrite the costs of one seminar, but should at this time authorize four five-day seminars. All costs, which included time for the instructor to develop written materials, a salary for his actual teaching time, and the rental of the facilities, would be paid by the Wisconsin Chapter.

The five-day seminar is recognized for credit by either the Milwaukee Area Technical College or Stout State University in Menomonie, Wisconsin. Both are members of the North Central Association.

The foundry facilities at the college would accommodate only 16, and even on relatively short notice we had no difficulty in getting a full class.

We asked the participants of this first seminar to give us a daily reaction as to how well they felt the information, the demonstrations and the actual shop work were meeting their needs. Most of the men said in effect, "This is the type of program I needed." "I can see some of the mistakes I was making." "This is the best help I ever got." From these reactions from the participants of the first two seminars, we got the impression that the men wanted a combination of theory, demonstrations and shop work. Several mentioned, too, that they would like to have some printed material covering the theory and demonstrations that they could read prior to coming to class and thus save some of the lecture time. It would also eliminate taking notes.

This has now been done, and the 1969 Christmas Seminar and the 1970 Easter Seminar verified the fact that providing concise written material that can be read before coming to the sessions permits more time for demonstrations and actual shop work.

The instructor, Jerry Miller, is a foundryman who has had a variety of experiences in the foundry, has taught apprentices, day and evening college students, and can now claim classes of teachers.

The prepared material has been reviewed by the technical staff of the American Foundrymen's Society for accuracy, and in my estimate and to my knowledge, is the best basic text on foundry work.

The Easter Seminar recently completed the four authorized by the Wisconsin Chapter, which gave approximately 64 teachers in the Milwaukee schools, as well as in some suburban schools, a first-hand foundry experience that will enable them really to teach foundry.

The lack of foundry equipment, such as melting furnaces and molding facilities, was never one of the problems in Milwaukee – most junior and senior high schools have reasonably good melting furnaces and molding areas. One or two of the older schools that were not well-equipped have, as the result of these seminars, budgeted and installed equipment because of the teacher's interest. Several of the local foundries have donated a jolt, squeeze molding machines and large flasks.

Student interest in casting, when assured of some measure of success, is tremendous. Students ask to come in before school or remain after school to make or shake out their mold. Boys who formerly were truant now come early to do their molding or clean up their castings. For some reason, the pouring of molten metal into a mold and extracting a useful or interesting object is fascinating to them.

I mentioned earlier that lack of qualified teachers was not the only thing that deterred the teaching of foundry. I'd like to review some of these other problems quickly, because perhaps our experiences may be helpful to you. The use of the conventional water-tempered sand was probably one of the biggest deterrents to a successful foundry experience.

In Milwaukee, most course offerings, including industrial arts, are offered for a single period per day, five days a week. A period is 45 or 55 minutes long, depending on whether the school has a 7- or 8-period schedule. Attempting to temper and make a mold with conventional water-tempered sand in a single period met with little success – particularly if the sand was used intermittently. When the sand was too dry, the mold would tend to collapse; and when too damp, the castings had excessive gas pockets.

After some experimentation, we have switched to a non-water-tempered molding sand. Its big feature, as far as we are concerned, is that it requires no tempering and is ready for instant use. With no moisture or permeability problem to be concerned with, we are able to use finer sand, assuring an improved finish. Here again we received splendid cooperation from the industry. Several foundries agreed to mix and mull the waterless sand for our use at cost, even though the foundry itself did not use it. We ordered it in two-ton lots, bagged it and put it in our supply warehouse for delivery to the schools on order. We are now able to obtain it from the Milwaukee Area Technical College at a very reasonable price. Many suburban schools have also switched to this waterless sand and are obtaining it through the Technical College. Its use has eliminated many problems. I recommend it for your use, particularly if the molding is done on an intermittent basis.

Another mistake we discovered was attempting to use aluminum scrap, particularly aluminum sheet. We found we had to heat it far beyond the melting point in order to get it sufficiently fluid to flow readily. This caused excessive shrinkage when it solidified. From the owner of an aluminum foundry we received some suggestions of two good aluminum casting alloys, and he arranged to have a salesman provide us with samples. The first of these had excellent casting properties and eliminated all former shrinkage problems, but it had a high silicon content that produced brittle castings, and the surface did not lend itself to a high polish.

The second alloy also had good casting properties, produced a ductile casting that lent itself to a high polish when buffed. It also has excellent tensile strength, having 30,000 to 34,000 PSI as cast, and increasing to 32,000 to 36,000 PSI after three weeks' aging at room temperature.

With these properties we are able to use it for projects normally made out of cast iron, yet having the advantages of the low melting temperature of aluminum.

I mention our experiences with the sand and use of scrap with a view to helping anyone who may be having some of the same difficulties we experienced. I might add that all of the suburban teachers who participated in the seminars have since switched to the use of the waterless sand, and most are now also buying the high tensile strength alloy.

These cast metals seminars, although originally sponsored for Milwaukee teachers and subsequently extended to some suburban teachers, were not intended to be limited to the Wisconsin Chapter. It was the intention, rather, that the Milwaukee seminars be used as a pilot program – that the four seminars be used to develop an in-service curriculum, a basic teaching text, and should experiment as to which is the best approach. If the teachers' reactions are any barometer, we believe we have now done this. How well we have done this can perhaps be judged by reading some of the comments from the participants of the last two seminars.

I suspect this is written by a teacher in one of the suburban schools:

"My evaluation of the metal casting course just concluded was that it was of great help. I will always be thankful for the enthusiastic contribution that Mr. Miller made and his influence and help towards helping me understand the foundry industry. It will be very apparent, and I believe I will be able to take back to the students advice and better instruction through better understanding of the foundry industry. I have learned a lot in a short period of time and believe this type of program should be made available to more metal instructors in high school metal courses. The course was very efficiently run, and how it could be improved on would be hard for me to suggest or advise. I will always be thankful for the contribution made towards my program and the help it gave me as an instructor in the metals area. Giving me the opportunity to take the course will always be appreciated. I would like to thank the American Foundrymen's Society, the Milwaukee Public School system and the Milwaukee Technical College and whoever else was responsible for this opportunity."

Another writes, "It is important for teachers to get new and fresh ideas from time to time. This is just what happened at the Metal Casting Seminar I attended this Christmas vacation, 1969. The time spent in the classroom was very informative, and I learned a lot. I heard many good ideas from fellow foundry teachers and will be able to use many of them in my foundry program. Most valuable of all was the time spent working in the shop. It is easy to talk about foundry and put things on paper but it can't stop there. We were able to work many hours and get our hands dirty and really learn. What I learned at this seminar will make my teaching job much easier both in the classroom and in the shop. It will also help me explain to the students just how important foundry really is to our nation and economy and point out to them the job opportunities and advancements available to them in the field of metal casting."

Teachers were free to make any comments they wished, as no signatures were asked for. The only adverse comment seemed to be that the class of 16 was a little crowded for the facilities.

The Wisconsin Chapter has now set up a permanent education committee which will arrange to continue to offer one casting seminar annually as long as there is a demand. With the prospect of many new teachers for expansion and replacement, it will likely continue for some time.

This experiment in Milwaukee has been watched by other local chapters of the American Foundrymen's Society throughout the country. The materials developed and the suggested approaches have been, or will be, made available to them by the national headquarters located in Des Plaines, Illinois. In the event you are interested in similar casting seminars in your area, contact your local foundry or write to Ralph Betterley, Education Director for the American Foundrymen's Society, for the name and address of the person to contact. (Mr. Betterley's address is found at the conclusion of his paper, elsewhere in this volume.)

Mr. Bohnsack is associated with the Milwaukee Public Schools, Milwaukee, Wisconsin.

metals and materials

Strengthening mechanisms in metals

David W. Guerdat

Introduction. In order to discuss the properties of a metal, we must learn something about the structure of the material we are dealing with and how it affects the properties.

The structure of the metal in a part is closely related to the maximum load the part can carry, the number of times a certain size load can be applied without failure, the effect of corrosive agents, and the way in which the part fails.

The structure of the metal determines: Maximum dead load, maximum repeated load, corrosive agents, failure (ductile) and failure (brittle).

The structure of a metal part depends on the thermal and mechanical treatments used to produce the part.

Crystal structure. A study of crystal structure makes a good starting place for our study of metal structure, since all solid metals are crystalline. Crystalline solids are characterized by the regular way their atoms are arranged in space.

If we look into a simple cubic material, we can picture the individual atoms as being spherical. Each atom has an attractive force which is pictured as six hands.

This attractive force is enjoyed by all the atoms in the solid metal. The atoms line up in rows and form a continuous grid. This uniform network is formed in three directions.

The atom's arms, which are in reality free electrons forming an electron cloud, act like springs. They stretch out when a tensile load is applied to a crystal and are shortened by a compressive load. When the load is removed, the crystal returns to its original shape.

$$\text{Strain} = \frac{\text{Elongation or change in Length}}{\text{Original Length}}$$

If the load is not large enough to cause a permanent change in size, the crystal is said to be loaded in the elastic region, and the strain is called elastic strain. If the load is great enough to cause the atoms to move or change their position, the crystal is said to be loaded in the plastic region, and the strain is called plastic strain. In other words, the strain has to do with the deflection under load, not with the load itself.

Division of the load in pounds by the original cross-section area in square inches gives the stress, which is expressed in pounds per square inch.

$$\text{Stress} = \frac{\text{Load in pounds}}{\text{Area in square inches}}$$

The stress is directly proportional to the applied load. The advantage of using stress rather than load lies in the shape of the material being tested. Crystals or bars of different cross-sectional area under the same load do not suffer the same stress. The behavior of materials under load depends on the force per unit cross-sectional area, the stress, and not on the magnitude of the load.

Solid solutions. We have been discussing the properties of pure crystals. However, almost all commercial metallic materials are combinations of several metals. If these elements are added intentionally, they are called alloying elements. If they are present due to the method used to produce the metal, they are called impurities. The basic types of solid solutions formed are two: interstitial and substitutional.

An interstitial solid solution is formed when the solute atoms are small enough to fit into the spaces between the regular solvent atoms. Ordinarily in metal crystals only hydrogen, carbon, nitrogen and oxygen are small enough to form interstitial solid solutions. There is a distortion in the lattice around interstitial solute atoms, since the atoms are larger than the available space. This misfit also limits the solubility to rather low percentages of solute.

Solute atoms may take the place of regular solvent atoms on the crystal lattice of the solvent. Such solutions where all the atoms are in regular lattice positions are called substitutional solid solutions, because the solute atoms are substituted for some of the solvent atoms. The solute atoms often differ in size and chemical nature from solvent atoms and thus cause local distortion in the crystal.

Dislocations and vacancies. So far, whenever we have looked into the crystal structure, we have seen a perfect and orderly arrangement of atoms. However, nature is never perfect, and these imperfections play an important role in the properties of materials. The two major defects are dislocations and vacancies.

Dislocations play a major role in the deformation of a crystal. The one type we will discuss, an edge dislocation, represents the edge of an extra plane of atoms. The atoms near the top of this extra plane of atoms are in compression. Those below are in tension.

These dislocations are formed by a force or a load applied to the crystal. If the load is in the plastic region, a dislocation will form and move through the crystal. The easier the dislocation moves through crystal, the lower the strength of the metal.

If we look once again at an interstitial solid solution, with reference to a dislocation, it can be seen that the interstitial atoms make it more difficult for the dislocations to move. Therefore, the crystal is harder. This restriction in movement of dislocations can also be seen in substitutional solid solutions. However, the degree of hardening varies with the size of the solute atoms.

Another defect in the crystal structure of a metal is known as a vacancy. The vacancy is simply the region where an atom should have been. The atom which formerly occupied the site of the vacancy has moved to another position. The vacancies will interact with dislocations, thereby affecting the strength of the metal.

Vacancies also affect the diffusion rate of one metal into another. The vacancy provides a space for solute atoms to move into. The greater the number or the more rapid the movement of vacancies, the faster the rate of diffusion.

This brief look into the structure of metals will help to provide a better understanding of the mechanisms used to strengthen metals.

Mr. Guerdat is coordinator for career development, American Society for Metals, Metals Park, Ohio.

Cold forming of metals

Walter E. Johnson

If any of you have noticed in straightening a bent nail how a little wrinkle or bump is still left after you pretty much straighten the ends, you will have been witness to a strengthening mechanism in steel. We call it "work hardening" in the trade, and without it we would require significant re-design and "beefing-up" of many parts cold formed from metals.

What happens when a metal is cold formed? First, metals are made up of crystals or grains. These crystals are composed of layers of atoms all uniformly lined up. Now every so often in these uniform atomic layers, there will be an atom slightly out of place. This is called a dislocation, and it is a weak spot in the atomic structure. Now, when a stress is put on the metal, the dislocations act as spots or lines where redistribution of atoms – or flow – can occur. Now as the metal flows or stretches, these dislocations begin to run into each other and prevent the continued easy flow of layers of atoms one over the other. Thus, it begins to take more and more force to make the metal flow. This is the crystallographic explanation of cold working or strain hardening. Thus, the fact that the nail was cold worked at the bend made it stronger than the unworked portion, and efforts to straighten it caused the softer and weaker part of the nail to deform first.

Most of you are familiar with the fact that you can heat up a piece of low carbon steel or unalloyed aluminum or brass and, if it has been cold worked, the heating followed by slow cooling will soften the metal. This is, of course, annealing or stress relieving, depending on how high a temperature to which you heat. In this case, the heat energy input lowers the internal energy needed to realign the atomic layers, getting rid of the piled-up dislocations. Thus, if the temperature is high enough, the distorted crystals are replaced by new, unstrained crystals, and the metal is softened by recrystallization. The temperature at which this reaction occurs is called the recrystallization temperature. In low carbon steel, this would be about 1300°F.

Now, suppose for a moment that we are carrying out a hot forging operation at about 1900°F. Would we be work hardening the material as we pound it into shape? No. As the crystals are deformed by the forging action, recrystallization simultaneously occurs, and a soft structure is maintained. Thus, we can see that whereas working below the recrystallization temperature of a metal hardens it, working above it does not. This latter process is commonly called hot working. Examples are hot extrusion of aluminum, hot rolling of steel and hot forging. Now cold working is commonly thought of as taking place at or near room temperature. However, you can bend a piece of lead or tin back and forth indefinitely at room temperature without hardening. This is because these metals recrystallize at temperatures below room temperature. Ask yourself, then, this question: Is the drawing of lead-tin solder into wire at room temperature cold or hot working?

Consider what practical information we would like to have to interest a student in metalforming. First, ponder the amazing changes occurring in the properties of work hardened metals. By work hardening, the tensile strength of copper can be nearly doubled.

Full hard steel wire can have a tensile strength of 270,000 psi developed. Annealing then can lower it to 60,000 psi. These changes are truly amazing.

What are the various methods of forming metal in sheets into useful shapes? First is simple bending over a radius. Then, we have flanging. Shrink flanging produces compression in the curved wall, and stretch flanging, tension as you might have in a flanged hole. These are often called extruded holes and are used in conjunction with thread-cutting screws in sheetmetal assembly.

Embossing is another metalforming technique used to stiffen a surface. No working occurs in adjacent flat surfaces, only stretching in the embossment. If fracturing occurs during embossing, it takes place in the die corner areas. Sometimes embossing is done in two steps. First, metal is gathered in a trough and then, in a second operation, the section is sharpened up. Beads and ribs in parts are examples of embossments.

In the deep drawing of cups, the first stage as the punch contacts the sheet is a form of embossing. This creates the cup bottom with no metal movement of the flange. As the punch moves into the die, the metal is pulled in from the flange at right angles to the punch movement. A segment of the flange then is compressed, bent and unbent as it flows into the die cavity. The most critical variables in deep drawing are:

(1) Blank diameter
(2) Lubrication
(3) Die radius - Steel, 2 t and S.S. or Al, 4-5t
(4) Blankholder pressure
(5) Speed of drawing. At very high speeds the blankholder pressure must be doubled or tripled to prevent wrinkling. Parts get very hot at 250 strokes per minute.

The maximum reduction from blank diameter to cup diameter is about 50%. If the metal is thicker, about .060", this can be increased to 60% and, if the metal is quite thin, say .020", the maximum reduction is about 47%. Wrinkling is more prevalent in thinner metal.

In making a rectangular box, the four corners are drawn. Without the corners, the sides experience merely a bend and straighten operation. If we take off the four corners and put them together, we have a round cup with a square blank. Thus, the corner has farther to flow in, and this increases the difficulty of the draw. With a round-cornered blank, we improve this condition, but this is expensive to build into the die. Usually we cut off the corner of the blank to minimize the problem. We can also increase the punch radius in the corners, which, in effect, lowers the draw ratio. As mentioned before, this is usually around 50%.

Of course, as the metal flow in the corners is restricted by the drawing action, the flow in the straight sides is relatively unhindered. Thus we end up with a lateral metal flow and, consequently, wrinkles, as the corner actually rotates. This can be overcome by retarding the side flow using draw beads. These are matching ridges in the die-blankholder surfaces which cause the metal to flow more slowly.

These variations in metal flow can all be monitored using etched grid patterns in the metal blank. Careful measurements of the amount of stretch and draw can be made in the critical areas using flexible scales. These measurements tell us how close we are to fracturing and can be used then to make die changes with some knowledge of the amount of improvement made. Limits on the amount of stretching and drawing that a piece of steel can withstand without necking-down and fracturing have been established. These are called formability limit curves. Thus, if the die conditions change, lubricant additions are made, or material properties change, the maximum strain in a part will change. A shop can thereby see how close they are to failure on a part by gridding a blank, forming it and plotting the strain in these circles.

Material properties. When a sheetmetal part is being formed in a press, and a rash of fracturing occurs, tests are run on the metal blanks. What meaningful tests can be run in a laboratory? Now you may recall the shape of a load-deformation curve which is generated when a sample of steel is pulled to fracture in a testing machine. A good deal of information can be obtained from these curves. The tensile strength, yield strength and other properties are well known. The ductility of a sample is reflected by the total elongation of the sample. This, of course, is the amount of stretch at fracture. Now, before fracture occurs, the sheet begins to "neck-down" in the critically-strained area. We can determine fairly accurately when this necking first begins on a tensile machine by looking at the elongation at the maximum load. Beyond that point more stretching is obtained with a decrease in load. After a sample "neck-down", there is very little useful stretch left, and thus, this point of deformation – called the uniform elongation – is important. This can be measured quite accurately and is now used as a significant indicator of steel stretchability. Now this measurement is sometimes called the strain hardening coefficient. You can appreciate the practical significance of this concept if you visualize the steel as having a capacity to absorb work hardening without becoming so brittle that "necking-down" and fracture occur. The higher this capacity, the more a metal can be stretched.

Steel makers have recently found that the uniform elongation can be increased by producing steel with (1) slightly larger grain size and (2) minimum temper rolling after annealing. By understanding these factors, large fabricators have been able to reduce costs by using commercial quality steel in place of drawing quality steel and by lowering scrap rates. Of course control of both steelmaking factors must be held. Too large grains cause an "orange peel" surface. No temper roll operation produces steel which will not lay flat and will exhibit "stretcher strain" marks when lightly deformed.

Another entirely separate factor related to deep drawn parts has the fancy title of normal plastic anisotropy. This can be visualized as a "resistance to thinning" in the side wall of a drawn cup. To measure the normal plastic anisotropy, or $\bar{r}$ value, as we will call it, the tensile sample is measured accurately and then pulled to 15% extension. Measurements are then made on the width, and, by a constant volume relationship, the ratio of width strain to thickness strain is calculated. The higher the $\bar{r}$ value the better, because this means that the metal, in being formed, tends to draw-in adjacent areas rather than thinning-out to accomplish the required amount of strain. Typical $\bar{r}$ values of some metals are listed below:

3003 aluminum	0.7
Hot rolled steel	0.9 - 0.95
Normalized steel	0.9 - 1.0
Cr-Ni stainless steels	0.8 - 1.0
Rimmed steel	1.0
Zero carbon steel	1.1 - 1.2
430 stainless steel	1.25
Killed steel	1.4 - 1.6
Titanium, beryllium	6-7

Titanium and beryllium have high $\bar{r}$ values, but lack the overall ductility as measured by uniform and total elongation to be drawn into a deep cup. Thus it is not enough to have a high $\bar{r}$ value only, because the strain near the cup bottom extends into the stretch portion of the strain field.

On some troublesome parts excellent correlation between properties and performance can not be obtained. These parts often have highly-strained critical areas bordering on fracture under even the best conditions. Oftentimes the fracturing will begin at an edge where a burr is raised. Moreover, the uniform flow of metal may not be reproduced during each hit because of lack of uniform holddown pressure as this edge is drawn into the die cavity. Changes such as these can be followed by using gridded blanks. In these situations, even the best material will fracture occasionally. The best solution here is an improved tooling arrangement.

The opposite condition, that is, restriction of metal flow, is also encountered. A step in a large flat panel or a two-level depression, such as in certain double sinks or oil pans, requires perfect die balance to make the draw. More than good steel is required. Preforms, pre-lanced holes or increased radii have been used to help draw metal into the critical areas. Recognition of these potential solutions comes from experience and may be more important than property correlation for some parts.

I have embellished heavily on the so-called strengthening mechanisms related to cold working of metals, but the practical implications of these mechanisms are at play in all of the items mentioned herein. They are not always obvious, but they are there working for us. Without them we would be out of business – at least until the chemists could come up with a plastic to take their place.

Mr. Johnson is manager, Metallurgy and Material Development, General Electric Company, Louisville, Kentucky.

Heat treatment of steel

Bobby L. Garner

What is heat treatment? It can be stated very simply as the controlled heating and cooling of metal. I emphasize the word control for both the heating and the cooling.

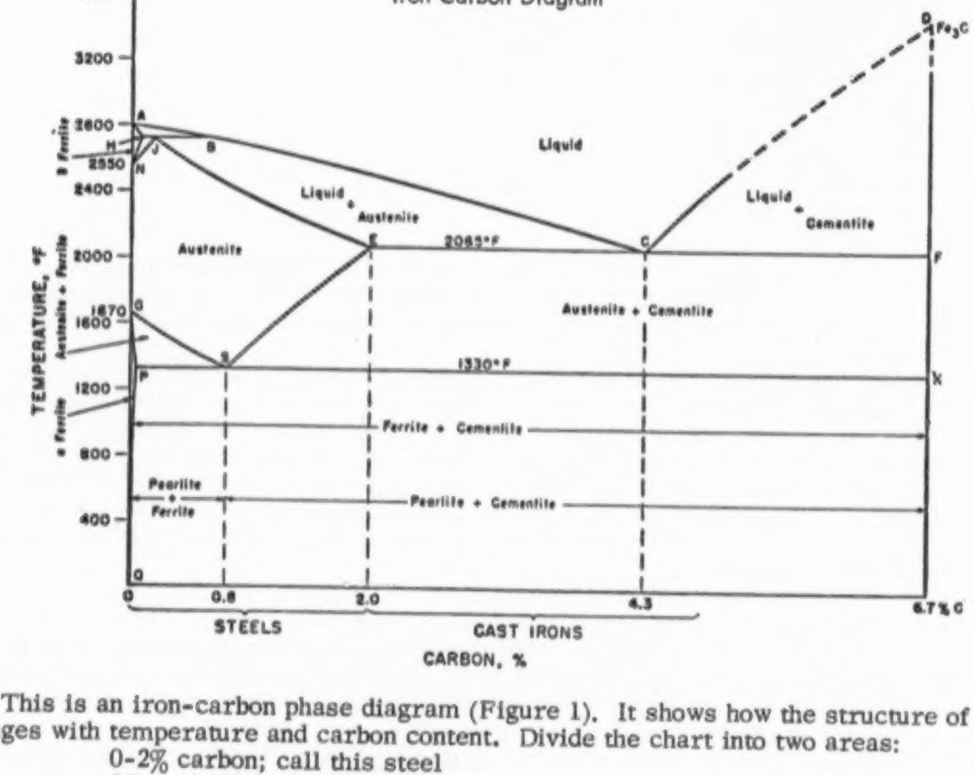
Why do we use it? For the same reason that the ancient sword makers of Damascus used it, to improve the mechanical properties of steel. These properties are hardness, strength, ductility and toughness. Some improvements are also obtained in machinability, forming and other metalworking processes.

How do we use it? To soften or to harden steel, but, like all technical people, we use special names like: Annealing (full anneal, spheroidizing anneal, isothermal anneal, normalizing, stress relief, recrystallization anneal and solution anneal); and hardening (quench hardening, marquenching, austempering, precipitation hardening and surface hardening).

Where do we use it? On steel.

What is steel? Steel is a material consisting of iron and carbon. There may be other elements present either as impurities or additions, but the basic strengthening agent in all steels is carbon, so at this stage we are interested in the interaction of the iron and carbon.

Figure 1
Iron Carbon Diagram

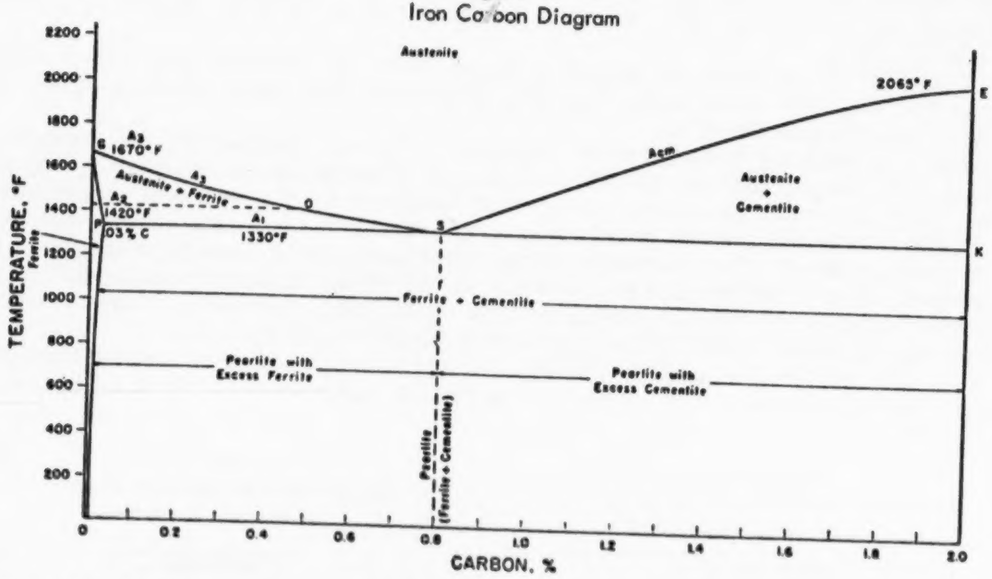


This is an iron-carbon phase diagram (Figure 1). It shows how the structure of iron changes with temperature and carbon content. Divide the chart into two areas:

0-2% carbon; call this steel
2% carbon up; call this cast iron.

Our prime interest is in the 0-2% area, since almost all commercial steel comes from this area. So let's look at that portion only. (Figure 2.)

Figure 2
Iron Carbon Diagram



Iron is an allotropic material. It can and does exhibit several crystal structures dependent upon the temperature. These are:

Ferrite is the low temperature structure. It is body-centered cubic in form and can hold only 0.04% carbon in solid solution.

Austenite is the elevated temperature structure. It is face-centered cubic in form and can hold up to 2.0% carbon in solid solution.

Martensite is a metastable structure and does not appear on the diagram, but it is very important. It is body-centered tetragonal in form.

What happens when steel is cooled very slowly from the austenite range? The carbon diffuses out of the FCC austenite as it transforms to BCC ferrite. As the cooling continues to below the eutectoid temperature (1330°F), the austenite transforms completely to ferrite, and the carbon that diffused out of the austenite forms an iron carbide called cementite, Fe_3C. The final structure at room temperature is a mixture of ferrite and cementite. A particular combination of ferrite and cementite is called pearlite. The foregoing is what happens during a full annealing operation and generally represents the softest state of steel.

If we increase the cooling rate until the steel is cooled rapidly, we come upon the basic mechanism of the strengthening of steel, quench hardening. Assume a steel with a carbon content of 0.6% heated in the austenitic range long enough for all of the 0.6% carbon to go into solid solution with the iron. Remember the austenite can hold up to 1.7%. The steel is then cooled rapidly. The carbon wants to diffuse out of the austenite, but it is trapped, due to the rapid cooling rate as the austenite transforms to ferrite. But the ferrite can only hold 0.04% carbon in solution, so the trapped carbon strains the crystal structure enough to form a new structure, a metastable body-centered tetragonal structure. This new structure is a super-saturated solution of carbon in ferrite, but it is called martensite. This martensite is very hard, strong and brittle. This is the material formed when steel is "heat treated". This very roughly describes the iron-carbon diagram.

Let's consider another approach: the time temperature transformation chart. Take a small thin piece of 0.80% carbon steel. Austenitize it by heating above the critical temperature. Quench it in water. The austenite will transform to martensite as previously described.

Take several similar pieces and austenitize them. Plunge these samples into a molten salt bath at T_1, which is below the critical temperature. The parts will immediately assume the temperature T_1 because of their small size. Now take a sample out after some seconds (a) and quench in water. Microexamination will show that the austenite has transformed to martensite as before.

Duplicate this but leave the sample at T_1 for increasingly longer time before quenching in water. After "b" second at T_1 and quenching, the structure will contain some pearlite (ferrite and cementite) in the martensite. Now increase the time at T_1, and increasing amount of pearlite will appear in the microstructure. So after some time at T_1, all the austenite transforms to pearlite, and there is no martensite when the sample is cooled to room temperature.

If you plot temperature vs. time at a temperature, the austenite will start to transform to pearlite after some time (P_s), and, after some later time, all the austenite will be transformed to pearlite (P_f).

When you vary the holding temperature, T_2 - T_3, etc., the time for the starting and finishing will change, and the pearlite will become finer in structure at lower temperatures. Also a different transformation product, bainite, is formed at lower temperatures.

At some lower isothermal transformation temperature, we can determine when martensite starts to form. The martensite forms instantaneously; it does not need an incubation period. But if left at that temperature, no additional martensite would be formed. So the temperature must be decreased in order to obtain 100% martensite. When we finish, you have the observed curve – an isothermal transformation curve.

Now that you have been exposed to the iron carbon phase diagram and the time temperature transformation curve, let's see if we can apply these to two of the processes that we use.

Figure 3
Schematic Transformation Diagram
for Conventional Annealing

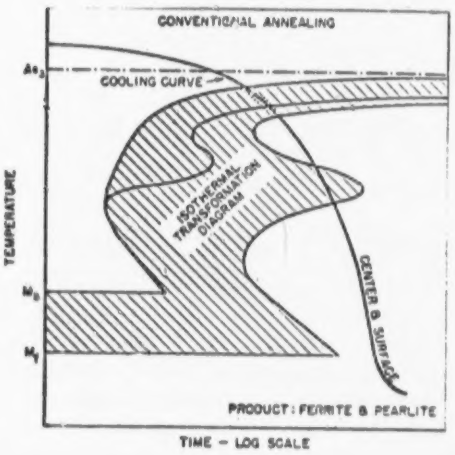
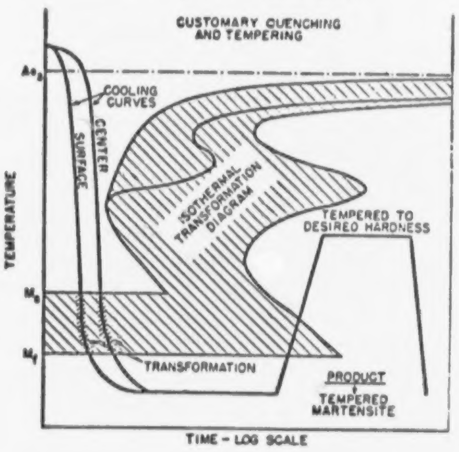

CONVENTIONAL ANNEALING
Ac_3
COOLING CURVE
ISOTHERMAL TRANSFORMATION DIAGRAM
TEMPERATURE
M_s
M_f
CENTER & SURFACE
PRODUCT: FERRITE & PEARLITE
TIME – LOG SCALE

Figure 4
Schematic Transformation Diagram
for Quench Hardening


CUSTOMARY QUENCHING AND TEMPERING
Ac_3
COOLING CURVES
SURFACE
CENTER
ISOTHERMAL TRANSFORMATION DIAGRAM
TEMPERED TO DESIRED HARDNESS
TEMPERATURE
M_s
M_f
TRANSFORMATION
PRODUCT
TEMPERED MARTENSITE
TIME – LOG SCALE

Annealing: (Figure 3)

Full anneal. - Steel is heated above its upper critical temperature and cooled very slowly in the furnace. This produces a coarse pearlite.

Hardening Processes: (Figure 4)

Quench hardening. - Heating above the upper critical temperature and cooling them by quenching in brine, oil or air. The quenching medium used is dependent upon the cooling rate required to harden the parts. This process is almost always followed by a temper process.

This is the standard heat treating procedure.

In the brief time allotted we have touched upon the heat treatment of steel with emphasis on the mechanism of strengthening. I would like to leave you with the thought that heat treating still plays a very important role in our society. Many of the products you use daily contain hardened steel, such as your automobile (gears, axles) and telephone (screws, springs).

Mr. Garner is a mettalurgist in the Appliance Division, General Electric Company, Louisville, Kentucky.

Precipitation hardening

Robert E. Seward

The precipitation hardening effect in metal alloys was discovered by Alfred Wilm (1) in Germany around 1910. He found that certain aluminum-copper alloys gave inconsistent test results when tested immediately after heat treatment as compared to being tested after storage at room temperature for a few days.

Tensile and yield strength as well as hardness was substantially higher in the "aged" specimens. This perhaps accounts for the term "age-hardening" being used to describe this phenomenon during early investigations.

Dr. Wilm thoroughly investigated these curious alloys, and the eventual result was the first industrial "age-hardening" alloy – called Duralumin. Even though the aluminum alloy was being successfully used, the explanation for its curious behavior remained a mystery for about a decade.

In June, 1919, Merica, Waltenberg and Scott presented a paper before the American Institute of Mining and Metallurgical Engineers which offered a satisfactory explanation. They suggested that at a temperature of 500°C, the copper contained in the aluminum alloy was completely dissolved in the aluminum matrix and, when cooled rapidly to room temperature, was retained forming a supersaturated solid solution. At room temperature, this supersaturated solid solution was unstable and tended to reach equilibrium by precipitation of the dissolved copper as minute crystallites of a compound, probably $CuAl_2$.

These men knew that when annealed at high temperatures, this alloy contained large crystals of $CuAl_2$ that could be easily seen under the microscope, and yet the alloy in this condition was quite soft. They therefore postulated that there must be a critical particle size for the $CuAl_2$ phase which would produce maximum hardness and thus maximum strength.

This explanation formed the foundation for our present theories of precipitation hardening alloys, both ferrous and non-ferrous.

In metallurgy, the term "age-hardening" is generally associated with hardening that occurs at room temperature. Precipitation hardening became a popular term after the mechanism described became apparent, and elevated temperatures were used to accelerate the hardening process.

In order to understand this strengthening mechanism a little better and to realize the importance of this group of metal alloys, we will choose a representative alloy and follow it through its "ordeal-by-fire". The aluminum-copper alloy system will serve this purpose very well.

Solid solutions: What is a "solid solution"? When one metal is capable of being dissolved in another while in the solid state, the result is what we call a solid solution. It is not a mixture but a true solution, in that the solute metal atoms may be randomly distributed in the solid, crystalline solvent metal matrix, much like sugar is dissolved in water.

Since the solid solution is crystalline, the dissolved metal atoms must reside at some point in the crystal lattice of the solvent metal. There are two possible locations for these atoms:

(1) in the spaces (interstices) between the solvent metal atoms, or
(2) at a lattice site normally occupied by a solvent metal atom.

The first type is called an interstitial solid solution, while the second is called a substitutional solid solution. (These are shown schematically in Fig. 1.)

Atoms form interstitial solid solutions only if they are physically small enough to fit reasonably well into the lattice spaces. Carbon or hydrogen in iron is an example of this type of solid solution and is obviously a very important one in industry today.

The type of solid solution we are concerned with in precipitation hardening is substitutional solid solution. Here the dissolved atoms are too large to fit into the spaces and must replace, or substitute for, one of the solvent atoms. Copper dissolved in aluminum is a very important member of this group.

Supersaturation of a solid solution. In order for precipitation hardening to occur in a metal alloy system, it must be capable of forming a supersaturated solid solution when rapidly cooled from some elevated temperature.

This capability is demonstrated by the equilibrium phase diagram for a system of metal B dissolved in metal A, shown in Fig. 2. The solvus line, separating the solid

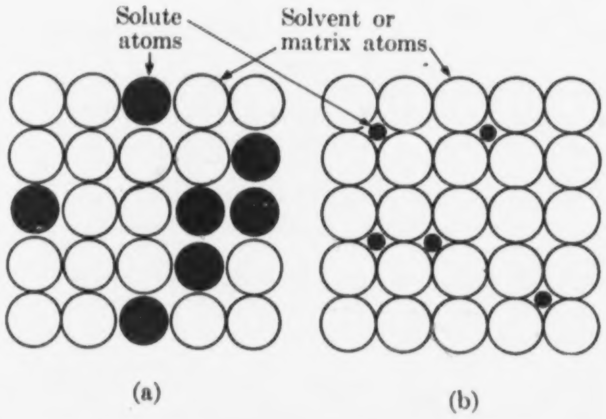


FIG. 1 - (a) SUBSTITUTIONAL SOLID SOLUTION
(b) INTERSTITIAL SOLID SOLUTION

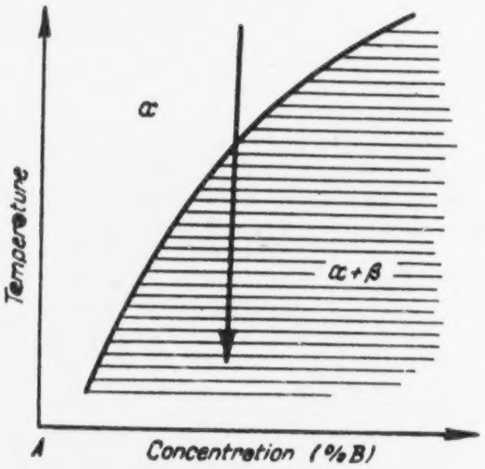


FIG. 2 - PARTIAL PHASE DIAGRAM OF A SOLID SOLUTION OF METAL B IN METAL A SHOWING A SLOPING SOLVUS LINE TYPICAL OF PRECIPITATION HARDENING ALLOYS.

solution from the two-phase region (+) which contains both the solid solution (   ) and the precipitated phase (   ), is sloping. A given alloy (indicated by the arrow), when heated above this line, will dissolve all of the atoms of the "B" metal present and exist as a complete solid solution. When rapidly cooled to a temperature below this line, it will try to precipitate out a second phase (   ) to satisfy the required equilibrium shown by the phase diagram. Until equilibrium is obtained at the lower temperature, the alloy is a supersaturated solid solution.

In the Al-Cu alloy system, the precipitation reaction proceeds slowly at room temperature and can be accelerated by heating it to a higher temperature, being careful not to cross the solvus line into the one-phase region.

Age-hardening is the term generally used for the reaction which proceeds at room temperature, while precipitation hardening is used to describe the same process occurring at elevated temperatures. These terms are many times used interchangeably, but we will confine ourselves to the hardening done at elevated temperatures, since only in this way can the alloys be reliably controlled to give the desired strength and hardness. Both temperature and the time spent at temperature control the properties of the hardened alloy.

The aluminum-copper alloy system. As stated before, the Al-Cu system offers a good example of the precipitation hardening mechanism.

Fig. 3 shows the actual equilibrium phase diagram for the Al-Cu system. Here we can see the sloping solvus line and the two-phase region (Al + $CuAl_2$). The precipitated phase now has a name – $CuAl_2$. This is an intermetallic compound containing (stoichiometrically) one atom of copper for every two atoms of aluminum.

We can also see the temperature used to produce the reactions required for precipitation hardening treatments: A) Solution heat treatment, B) annealing and C) precipitation hardening.

Solution heat treatment. This treatment is required to prepare the alloy for hardening. As Fig. 3 shows, the temperature is high enough to put the alloy into the one-

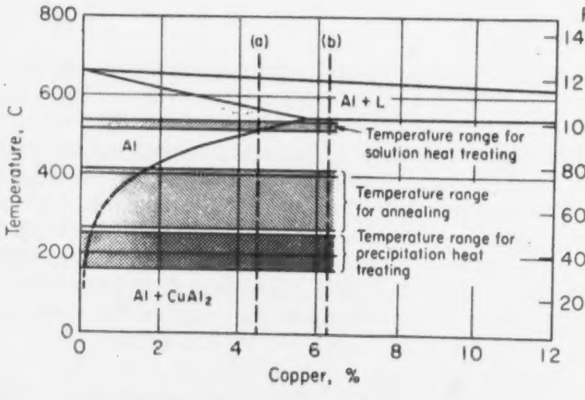


FIG. 3 - PARTIAL PHASE DIAGRAM FOR ALUMINUM-COPPER ALLOY SYSTEM SHOWING HEAT TREATMENT RANGES FOR PRECIPITATION HARDENING.

phase region where all of the copper dissolves in the aluminum matrix. For an Al-4.5% Cu alloy, this temperature would be about 950°F (510°C). After allowing time for the copper to dissolve, the alloy is quenched to room temperature. We now have a supersaturated solid solution which is relatively unstable.

Precipitation hardening heat treatment. The quenched alloy is now heated to the desired precipitation hardening temperature (between 300° - 500°F). At this point the increased mobility of the "trapped" copper atoms, due to thermal agitation, allows the onset of precipitation to occur by nucleation of the second phase – $CuAl_2$. By controlling the time and the temperature of precipitation, we can cause the alloy to harden and strengthen to the desired levels.

The precipitation mechanism. Let's look now at the events which take place during the precipitation of the $CuAl_2$ phase. Fig. 4 illustrates the atomic lattice arrangement present in the solution heat treated and quenched alloy. Notice that the solute copper atoms (black circles) are distributed randomly in the aluminum matrix (open circles). The free energy of this system is much higher than it would like to be (i.e., an unstable structure).

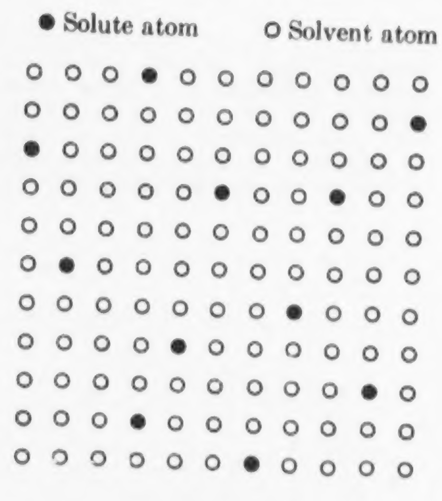


FIG. 4 - RANDOM DISTRIBUTION OF SOLUTE ATOMS IN SOLVENT METAL MATRIX AFTER SOLUTION ANNEALING.

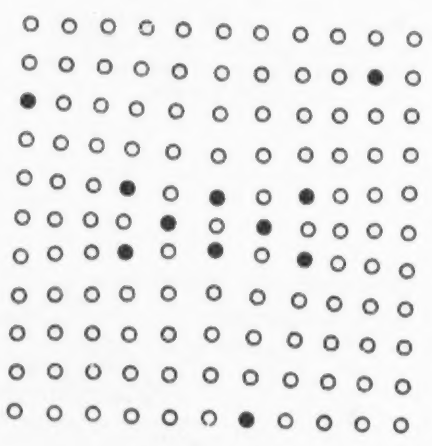


FIG. 5 - CLUSTERING OF SOLUTE ATOMS DURING EARLY STAGES OF PRECIPITATION HARDENING HEAT TREATMENT.

Fig. 5 shows what happens soon after the alloy has reached precipitation hardening temperature. The copper atoms are beginning to cluster (or nucleate), thus lowering their free energy. As this clustering proceeds, we reach a point where the $CuAl_2$ compound can form and thus lower the free energy of the system still further. When the stoichiometric proportions are satisfied, the $CuAl_2$ phase will break away from the lattice (lose coherency), and we have a microstructurally visible second phase (Fig. 6). From this point on, the time spent at temperature merely allows the $CuAl_2$ crystallite to grow.

Lattice coherency theory. We can explain the increase in hardness and strength, as well as the loss of it through annealing, by a "lattice coherency" concept.

Fig. 7 illustrates the principle of lattice coherency (or lack of it) in schematic form.

During the early stages of precipitation (i.e., nucleation stage), the solute atoms distort the matrix as they begin to cluster together (remember this is a substitutional solid solution). The lattice strains to accommodate the group of solute atoms, as shown in (a) or (b) in Fig. 7. These lattice strains are responsible for the increased hardness and strength of the alloy at this point.

As nucleation continues, the lattice strains become too high to maintain coherency, and the lattice "snaps" loose from the precipitated phase ($CuAl_2$), and each phase assumes its low-energy lattice shape, as shown in (c) or (d) in Fig. 7. Boundaries are now formed between the separate phases, which can be seen microscopically.

Just before this occurs, the alloy was in its hardest and strongest state. It will not begin to soften as the newly-precipitated phase grows. This denotes the onset of "overaging".

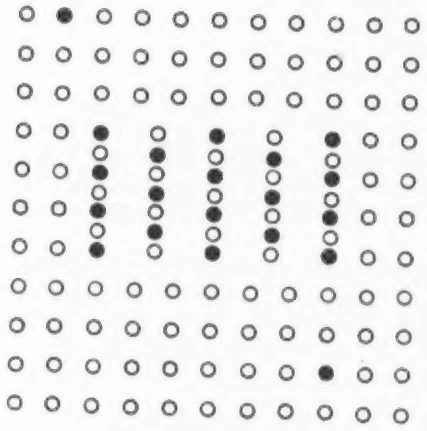


FIG. 6 - LATE STAGE OF PRECIPITATION HARDENING SHOWING FORMATION OF A DISCRETE SECOND PHASE (INTERMETALLIC COMPOUND SUCH AS $CuAl_2$ IN Al-Cu ALLOY SYSTEM).

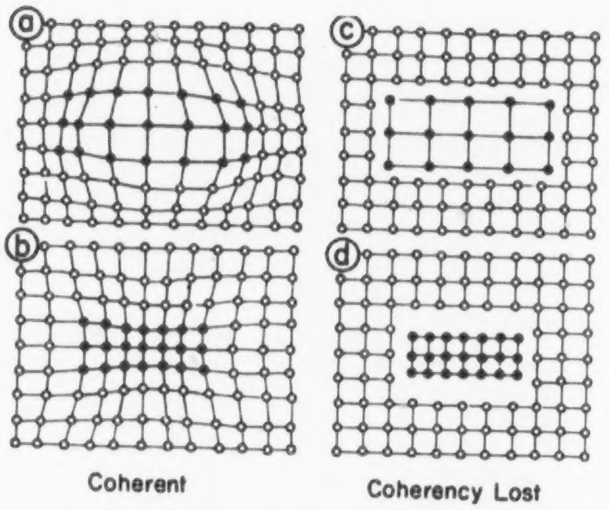


FIG. 7 - COHERENCY OF PRECIPITATED PHASE SHOWN IN SCHEMATIC FORM. MAXIMUM HARDNESS AND STRENGTH EXHIBITED BY COHERENT PHASE AS SHOWN IN (a) AND (b). PRECIPITATED PHASE WILL LOSE COHERENCY (c & b) AT HIGHER TEMPERATURES OR AFTER EXTENDED TIMES AT PRECIPITATION TEMPERATURES (OVERAGING).

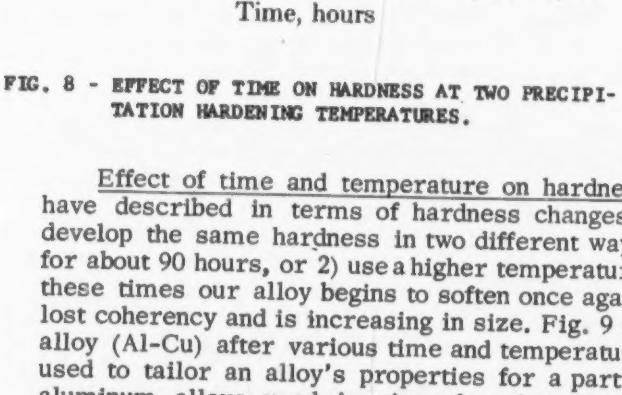


FIG. 8 - EFFECT OF TIME ON HARDNESS AT TWO PRECIPITATION HARDENING TEMPERATURES.

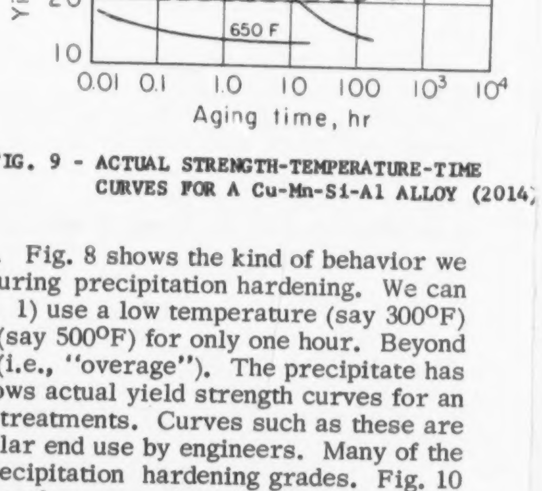


FIG. 9 - ACTUAL STRENGTH-TEMPERATURE-TIME CURVES FOR A Cu-Mn-Si-Al ALLOY (2014

Effect of time and temperature on hardness. Fig. 8 shows the kind of behavior we have described in terms of hardness changes during precipitation hardening. We can develop the same hardness in two different ways: 1) use a low temperature (say 300°F) for about 90 hours, or 2) use a higher temperature (say 500°F) for only one hour. Beyond these times our alloy begins to soften once again (i.e., "overage"). The precipitate has lost coherency and is increasing in size. Fig. 9 shows actual yield strength curves for an alloy (Al-Cu) after various time and temperature treatments. Curves such as these are used to tailor an alloy's properties for a particular end use by engineers. Many of the aluminum alloys used in aircraft today are precipitation hardening grades. Fig. 10 shows the microstructural changes visible under the microscope when the alloy goes from the solution treated condition to the precipitation hardened condition.

Physical property changes. Not only do the hardness and strength change during the precipitation hardening treatment, but so also do many of the other physical properties, such as: 1) specific volume (Fig. 11) and 2) electrical conductivity (Fig. 12).

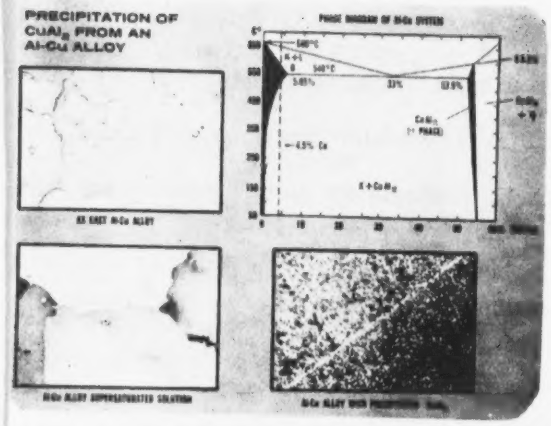

PRECIPITATION OF CuAl₂ FROM AN Al-Cu ALLOY
PHASE DIAGRAM OF Al-Cu SYSTEM
548°C
5.65%
33%
52.5%
4.5% Cu
CuAl₂ (θ PHASE)
K+CuAl₂
AS CAST Al-Cu ALLOY
Al-Cu ALLOY SUPERSATURATED SOLUTION
Al-Cu ALLOY WITH PRECIPITATION

FIG. 10 - MICROSTRUCTURES OF AN Al-4.5% Cu ALLOY AFTER VARIOUS HEAT TREATMENTS.

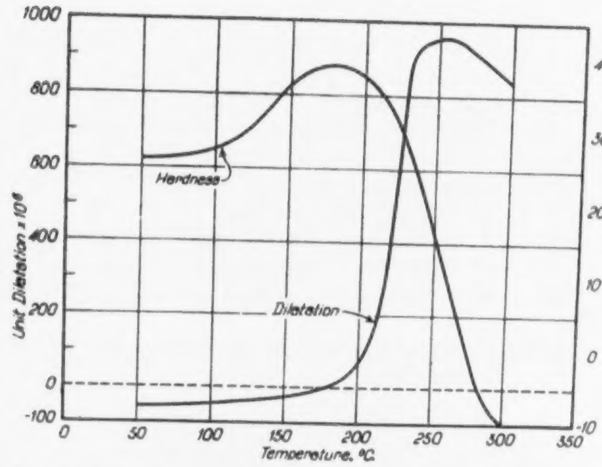


FIG. 11 - EFFECT OF TEMPERATURE ON HARDNESS AND UNIT DILATATION OF A PRECIPITATION HARDENING ALUMINUM-COPPER ALLOY (AFTER 8 HOURS AT TEMPERATURE).

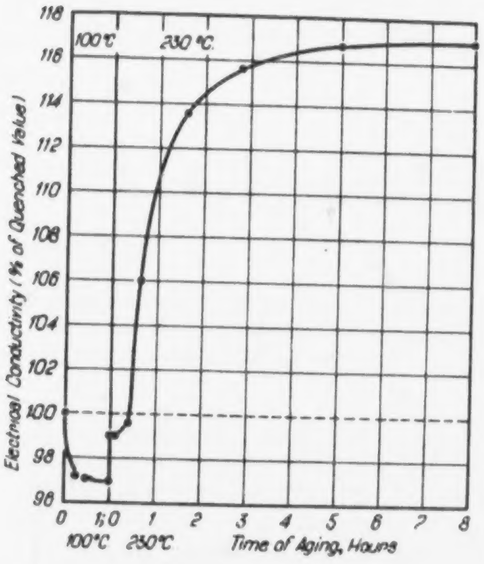


FIG. 12 - EFFECT OF PRECIPITATION HARDENING ON THE ELECTRICAL CONDUCTIVITY OF AN Al-Cu ALLOY. (ONE HOUR AT 100°C, REHEAT TO 230°C).

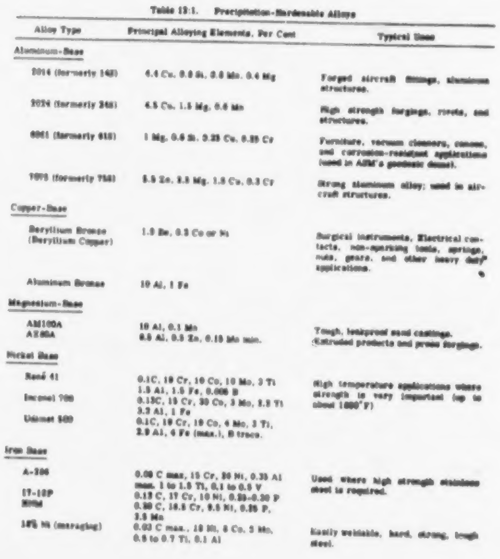


Table 13:1. Precipitation-Hardenable Alloys

Alloy Type	Principal Alloying Elements, Per Cent	Typical Uses
Aluminum-Base		
2014 (formerly 14S)	4.4 Cu, 0.8 Si, 0.8 Mn, 0.4 Mg	Forged aircraft fittings, aluminum structures.
2024 (formerly 24S)	4.5 Cu, 1.5 Mg, 0.6 Mn	High strength forgings, rivets, and structures.
6061 (formerly 61S)	1 Mg, 0.6 Si, 0.25 Cu, 0.25 Cr	Furniture, vacuum cleaners, canoes, and corrosion-resistant applications (used in ASM's geodesic dome).
7075 (formerly 75S)	5.5 Zn, 2.5 Mg, 1.5 Cu, 0.3 Cr	Strong aluminum alloy; used in aircraft structures.
Copper-Base		
Beryllium Bronze (Beryllium Copper)	1.9 Be, 0.2 Co or Ni	Surgical instruments, Electrical contacts, non-sparking tools, springs, nuts, gears, and other heavy duty applications.
Aluminum Bronze	10 Al, 1 Fe	
Magnesium-Base		
AM100A AZ80A	10 Al, 0.1 Mn 8.5 Al, 0.5 Zn, 0.15 Mn min.	Tough, leakproof sand castings. Extruded products and press forgings.
Nickel Base		
René 41	0.1C, 19 Cr, 10 Co, 10 Mo, 3 Ti 1.5 Al, 1.5 Fe, 0.005 B	High temperature applications where strength is very important (up to about 1800°F)
Inconel 700	0.12C, 15 Cr, 30 Co, 3 Mo, 2.2 Ti 3.2 Al, 1 Fe	
Udimet 500	0.1C, 19 Cr, 19 Co, 4 Mo, 3 Ti, 2.9 Al, 4 Fe (max.), B trace.	
Iron Base		
A-286	0.08 C max, 15 Cr, 26 Ni, 0.35 Al max. 1 to 1.5 Ti, 0.1 to 0.5 V	Used where high strength stainless steel is required.
17-10P HNM	0.12 C, 17 Cr, 10 Ni, 0.25-0.30 P 0.30 C, 18.5 Cr, 9.5 Ni, 0.25 P, 3.5 Mn	
18% Ni (maraging)	0.03 C max., 18 Ni, 8 Co, 5 Mo, 0.5 to 0.7 Ti, 0.1 Al	Easily weldable, hard, strong, tough steel.

FIG. 13 - EXAMPLES OF SOME PRECIPITATION HARDENING ALLOY SYSTEMS AND THEIR USES.

These changes are not too important in most applications but must sometimes be considered. As shown in Fig. 11, the volume increase (unit dilatation) at higher temperatures is large enough to be significant if close mechanical tolerances were involved.

Fortunately, maximum hardness and strength are achieved before much volume change occurs, and only in the "over-aged" condition does the volume grow markedly.

Not much use has been made of the conductivity change in present applications. It has helped in some of the theory development for precipitation reactions.

Alloy types and applications. There are many more alloy systems which exhibit precipitation hardening behavior. Fig. 13 lists some of the more important ones.

Research into the ferrous alloys has led to the development of very important alloys in the stainless steel class.

Volumes of material have been published, and many scientists and engineers have devoted full time to the study of precipitation hardening mechanisms and reactions.

This work continues, and new alloys will no doubt be developed utilizing this very interesting and useful phenomenon.

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(3) "Aluminum," Vol. I, Properties, Physical Metallurgy and Phase Diagrams, American Society for Metals.
(4) "Precipitation Hardening," Edited by Ralph E. Edelman for Metals Engineering Institute, A Division of American Society for Metals.
(5) ASM Educational Visual Aids for Material Science, Series 7.

NOTE: The figures used were taken from the above references and renumbered as follows:

Reference Taken From	Figure Numbers
(1)	Fig. 2, 11, 12
(2)	Fig. 1, 4, 5, 6, 8
(3)	Fig. 3, 9
(4)	Fig. 7, 13
(5)	Slide 1, Fig. 10

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Materials review, testing and processes

Syd K. Lee

I invite you all to join me on a tour of the Materials Laboratory in the Industrial Education Department of the University of British Columbia. Just before we begin our tour, I would like to mention two principles upon which I feel the success of a materials course rests.

The study of materials science has tremendous scope; one can earn a doctorate in any one of many materials areas and then proceed to spend a lifetime in research in this single area. Hence, it is not surprising to see some educators in university or college industrial education departments teaching a materials course which leans very heavily toward the theoretical. This "textbook and chalkboard" approach is not what we need in industrial education. Instead there needs to be a balance struck between theory and related laboratory experimentation. I like to consider the lab as a proving ground for materials theories.

In the schools this principle is even more important, for unless today's teacher can create a situation in which the student can see a relationship between what is being studied and a present or future need, the student will likely lose interest and is only wasting his time. Experimentation can be the bridge between the theory and the need. In short, a materials course needs to be lab-oriented to be a success.

The second point is applicable to educators in materials courses taken by industrial teachers-in-training.

Many university and collegiate industrial education departments contain sophisticated engineering-type testing machines and instruments; it is the rare (secondary) school indeed that can make this claim. Therefore, in addition to some standard engineering tests, there need to be opportunities provided for students to experiment with testing equipment that is or should be found in the school.

Provision should be made for the student to develop one or more simple machines or learning devices which he can use in school for the purpose of demonstrating properties of materials or industrial processes. In the following, you will see how student teams can be performing standard tensile tests, while at the same time elsewhere in the lab a team will be conducting the school version of the tensile test on equipment that is found in the school.

Join with me now as we explore the exciting world of materials science.

General testing. When the student walks into a materials lab for the first time he is confronted with a wide array of strange-looking apparatus. To permit an early acclimatization to this strange environment, he needs to be introduced to as many of the common destructive and non-destructive tests as soon as possible before he proceeds to specialization within one materials area.

Tensile testing. The standard tensile test gives us many of a material's mechanical properties. Properties such as yield and ultimate strengths, modulus of elasticity, percent elongation, percent reduction in area and true toughness should become part of the student's vocabulary when comparing materials.

In the school, a simple tensile specimen made by the student from band iron yields all of the above properties with the possible exceptions of the modulus of elasticity and the yield strength.

Compression testing. The student can gain insight into the compressive properties of a variety of metallic and non-metallic materials with a typical school universal testing machine (UTM). The yield strengths of the metallics can easily be found by using a micrometer and repeated load-unload cycling. As ductile metals are plastically (permanently) deformed, they assume a barrel-like shape. This behavior can be compared to the sudden failure of brittle cast iron or to the collapse of cells in a wood specimen.

Shear testing. Although not as common as the tensile or compressive test, the shear test is one that appeals to many students. A selection of metallic and non-metallic materials can be tested and their ultimate shear strengths compared.

Hardness testing. The accurate measurement of a material's hardness is a common test in nearly all quality control labs. For example, a Rockwell hardness check on a quenched carbon tool steel will reveal whether or not the hardening operation was effective. A Shore durometer A-2 hardness test run on a vulcanized tire will determine if the vulcanization has reached its end point.

The school UTM will permit Brinell hardness tests. An inexpensive Rockwell-type hardness tester is available and is quite suitable for the school lab.

The Mohs scale of mineral hardness still finds a few applications today, notably in the identification of minerals.

Impact testing. A Charpy or Izod impact test performed on materials such as mild steel and nylon will reveal that at low temperatures these normally tough materials fracture in a brittle fashion. At -120°F., an SAE 1080 mild steel requires only two or three foot-pounds of impact energy to cause fracture; at room temperature the energy required is about 140 foot-pounds.

As impact testing machines are costly and yet are simple in design, it remains for the teacher to assist a team of enthusiastic students in the construction of one of their own. The low temperatures can be reached and held by preparing mixtures of solvents and dry ice:

acetone -120°F.
chloroform -83°F.
ethylene dichloride -33°F.
carbon tetrachloride -11°F.
benzyl alcohol 5°F.

The practical significance of the dramatic impact test must not be overlooked. Examples of structures that have failed under impact loads at sub-zero temperatures are numerous. Bridges, Liberty ships and bulldozer parts are only a few.

Photoelastic stress analysis. The study of stressed plastics under polarized light is a popular one with materials students. Points of stress concentration in Plexiglas models can be readily seen and then related to the nose radius on a thread cutting tool or to the surface finish on a minibike axle being turned in the school metal shop.

Dye penetrant testing. This non-destructive test incorporates a crack-seeking fluorescent powder and a long-wave black ultraviolet lamp to detect the presence of surface cracks or porosity in a part. The cleaner, dye penetrant and developer are sold in aerosol cans at a modest price. The interest created in the student as he tests his automobile crankshaft for cracks can motivate him to investigate other non-destructive tests, such as magnetic particle, ultrasonic and X-ray.

Rigidity testing. A simple set-up on the school UTM will illustrate the relative stiffness of a selection of materials. Bars of identical size are each tested in three-point loading fashion until the bar is deflected a set amount. The loads required to cause the deflection are compared. It will surprise many students to learn that a mild steel has the same stiffness as a high-strength, high carbon steel in a hardened condition.

Crystallography. Before entering the metals and alloys field, it would be appropriate for the students to gain some insight into the structure of crystalline materials.

Glass beads. The atomic arrangements that exist within crystalline material as it slowly cools from the gaseous to the liquid state, and then to the solid state, can be shown in a simple way on the overhead projector. Glass beads are placed in a transparent dish and positioned on the projector to illustrate atomic spacing, long-range order and grain-boundary disorder. The principle of alloying is illustrated by adding beads of a different size or color.

Unit cell models. The repeating unit cells in a metal's space lattice can be represented in three dimensions using three-inch styrofoam plastic balls. The body-centered cubic, face-centered cubic and hexagonal close-packed unit cells can be constructed by the student, and then the concepts of atomic packing, slip planes and the differences between solid solution types are grasped more easily.

Microscopic study of crystals. The microscope opens the door to a new and exciting world for the student. By closely examining the crystallization of a drop of copper sulfate solution under the microscope, the student is better able to visualize the solidification of a molten metal into a polycrystalline solid.

A microscope that is equipped with inexpensive polarizing filters enables the viewer to observe crystals in a spectrum of colors.

Metallography. Metallography is a branch of metallurgy which involves the examination of metal structures, usually employing a microscope. The metals instructor in the school is in an ideal position for introducing his students to elementary metallography.

Specimen preparation. The beginning student is wise to start with a mild steel, since its preparation is not difficult.

Sectioning. A specimen is sawn and filed to reveal a reasonably smooth and flat transverse or longitudinal surface.

Mounting. To facilitate handling during the grinding and polishing steps and during the micro-examination, small specimens can be mounted in a polyester casting resin.

Wet grinding. The student uses a coarse grit silicon carbide paper (240) positioned on a sheet of plate glass to remove the scratches left by the sawing and filing operations. Papers of grit size 320, 400 and 600 are used to complete the grind phase.

Wet polishing. A successful polishing job will result in a mirror finish on the specimen surface. Aluminum oxide abrasives of micron size 1.0 and 0.3 are used.

Etching. A polished surface will not reveal anything until it has been etched with a 2% solution of concentrated nitric acid in methanol (nital). The etchant is applied with a cotton swab for about 10 seconds and then removed by washing in straight methanol.

Examination of fasteners. Stove bolts, rivets, screws and nails made from mild steel will provide interesting structures for examination. For example, the grain flow or grain discontinuity present in a wood screw will reveal whether the screw threads were cut or rolled. The carbon content of the steel can be closely determined.

Metallurgy. Briefly stated, metallurgy is the science and technology of metals. It is a very broad field which contains many principles and experiments that are suitable for inclusion in the school metals course.

Alloying. The largest percentage of metals produced are not pure metals but alloys composed of two or more metals. To introduce a student to some of the principles of alloying, the lead-tin system is especially appropriate.

Each student can make up an alloy of lead and tin and then plot a cooling curve for the alloy as it slowly cools from the liquid to solid state. The inflections in the curve give the liquidus and solidus temperatures, which are transferred to a graph of temperature against composition. If each student prepares a different alloy, a phase diagram can be constructed which closely resembles the one given in *Metals Handbook*, Volume 1.

The study of this diagram will reveal to the student the reason radio solder is of eutectic composition; whereas, plumbers' wiping solder is of a slightly different composition.

Heat treatment of high carbon steel, SAE 1080. The terms hardening and tempering are frequently misused by the metals student. Laboratory experimentation involving austenitizing, quenching and hardness testing followed by tempering and additional hardness tests should remedy this problem.

Impact testing performed on hardened specimens that have been tempered at different temperatures will reveal the relationship between toughness and tempering temperature.

Heat treatment of aluminum alloy AA 2024. The solution heat treatment and natural age hardening of this aircraft alloy is a process that lends itself to the school metals course.

Retardation of natural aging can be accomplished by placing the solution-treated alloy in the freezer section of a refrigerator. The identical alloy that is stored at room temperature greatly increases in strength in as few as five days.

Powder metallurgy. Powder metallurgy (P/M) is the process of producing finished metal parts by compressing metal powder in dies having the shape of the desired part. P/M parts are found in automotive transmissions, household appliances, copying machines and in a host of other applications.

In the school a metals student can press iron or copper powder in a shopmade die to a pressure of about 20 tons per square inch. The "green briquette" that is produced is very fragile at this stage.

The sintering or heating operation produces a strong and hard part that closely resembles a part machined from cast metals. To protect the part from oxidation, a reducing atmosphere can be created by immersing the part in granular charcoal held in a crucible. Copper parts require a 1500°F. sintering temperature; whereas, iron parts require 1900°F. Twenty minutes at temperature is ample sintering time for small parts.

Additional experiments. The American Society for Metals has published an introductory book of experiments entitled, Metals Technology, which should be of assistance to students planning further metals study.

Wood. Here is a material area which has excellent potential for lab experimentation.

Wood structure. A sharp knife will enable a student to explore the cross sectional, tangential and radial surfaces of a wood specimen. Through a low-power hand lens (10-14x), he will be able to recognize characteristic features of the species. For example, the white oak can be distinguished from the red oak by the presence of a cellular growth called tyloses in the pores of the white oak only.

A true fir can be distinguished from the Douglas fir by the lack of resin ducts in the true fir.

The student can learn a lot about wood structure if he prepares mounted and stained microscope slides. A single-edge razor blade will produce a thin chip suitable for examination. Overnight soaking in water will make slicing easier.

A phloroglucinol stain will provide contrast to the wood cut, because it turns lignified tissue red; the intense red remains for only a few days.

Formulation;

phloroglucinol	1 g.
ethanol	25 ml.
conc. HCl	25 ml.

The stored starches in the ray parenchyma cells of sapwood cut from a standing tree turn blue-black when reacted upon by an iodine-potassium iodide stain.

Formulation;

I_2	1 g.
KI	1 g.
H_2O	100 ml.

Moisture content. The student can use two methods to determine the moisture content of a wood specimen: the electrical meter method, which is very rapid, and the oven-dry method, which is much slower but very accurate.

Wood deterioration. Wood with more than 20% moisture content is susceptible to the growth of microorganisms that cause stains and moulds. Whereas stains do not affect the strength of wood, moulds feed on one or more of the wood constituents, thereby weakening the wood.

A soil block test can be set up in the school which will provide some interesting results. If fungus spores are introduced into a bottle containing sterile soil to which a small quantity of agar solution has been added, a mould will appear on the damp soil after a few days. Decay in a series of blocks of different species will result in a loss of weight and size.

The resistance to deterioration offered by redwood and Western red cedar can be verified by this test. The effectiveness of commercial wood preservatives can also be checked.

Pulp preparation. Pulping of softwoods and hardwoods can be accomplished by placing matchstick-size wood pieces in a test tube containing concentrated acetic acid and 30-35% hydrogen peroxide. The tube is placed in a boiling water bath and held there until the matchsticks are uniformly white. Mild shaking will cause the fibers to separate. Fibers of different species can be compared if a few drops of fiber suspension are placed on a microscope slide and allowed to dry.

Paper preparation. A paper hand sheet can be prepared by pouring the above pulp onto a wire screen and allowing the water to escape. The screen and paper are placed in an oven at 60°C. until the paper is dry.

Additional experimentation. The booklet, *Classroom Demonstrations of Wood Properties*, by A. N. Foulger, US Department of Agriculture, is available from the Superintendent of Documents, US Printing Office, Washington, DC, 20402, for sixty cents.

Plastics. It is estimated by the Society of the Plastics Industry that by the year 1983 the volume of plastics used for all purposes will exceed the volume of metals.

Structure. The structure of several common thermoplastic and thermosetting plastics would be worthy of including in a plastics course in the school. A condensation polymerization reaction can be demonstrated by mixing the following solutions:

Solution A:

4.4 g	1,6 Hexanediamine
50 ml.	water

Solution B:

2 ml. sebacyl chloride
100 ml. carbon tetrachloride

Solution A is added to solution B, resulting in a nylon membrane forming at the interface of the two solutions. A continuous strand of the plastic can be withdrawn from the container on a rotating stirring rod.

Caution: The chemicals are corrosive and dangerous to breathe. Use a fume hood.

Identification. It is often desirable to make a quick identification of a plastics material. After determining whether the plastic is thermoplastic or thermosetting, an examination is made as to general appearance and odor when heated in an open flame. Once a tentative identification is made, the student can refer to reference listing properties and confirm his identification by conducting specific tests.

Moulding processes. There are a number of small moulding machines available that are suitable for demonstrating injection, blow, vacuum, compression and rotational moulding.

Resistance to chemicals. Common household and industrial chemicals and solvents can be placed in contact with a selection of plastics materials for purposes of comparing chemical resistances.

Resistance to ultraviolet light. Plastics materials can be exposed to a strong source of UV light to determine their resistance to fading and deterioration. If a mercury lamp is not available, an extended outdoor exposure test would give valuable results.

Paints. The public relations manager of a large paint plant will often supply a teacher with generally-known formulations for an alkyd enamel and an acrylic emulsion paint.

Fineness of grind testing. The size of the pigment particles in the lab-made paint can be found using a fineness of grind gauge.

Pigment hiding power testing. A film of paint is applied to a checkerboard hiding power chart, and the hiding power is determined by the paint's ability to cover the black squares.

Flexibility testing. Strips of tinplate on which films of paint have dried are bent around a series of mandrels. The flexed areas are examined closely for the presence of cracks.

Exposure testing. A long-term exposure test that simulates in-service conditions can be performed on lab-made and commercially-made paints on a rooftop exposure rack. The test panels are approximately 3 inches wide by 12 inches long and are arranged vertically on the rack. For greater exposure, some panels may be angled at 45°.

Concretes. There are many interesting experiments that can be performed in the area of cements and concretes that will lead the student to a better understanding of the principles of quality concrete.

Portland cements. There are five types of Portland cement, each designed for a particular application. For example, Type I is a general purpose cement, while Type III is a high early-strength cement.

A student can prepare several batches of concrete, each employing a different type of cement. These concretes are cast in cylinder moulds, and the set specimens are cured under water for at least one week. The compressive strengths of each concrete can be determined and then related to the type of cement used.

Water-cement ratios. The ratio of water to cement (W/C) greatly affects the compressive strength of a concrete. By performing compressive strength tests on concretes having different water-cement ratios, the student will learn that concrete that has a high

W/C ratio is a weak concrete. Typical W/C ratios used in this test are 0.4, 0.5, 0.6 and 0.7.

Curing media. Concrete cylinders that have identical W/C ratios can be divided into three groups. Each group is then cured in a different medium: under water, in air at 100% relative humidity, and in air at normal room humidity. The compressive strengths will be affected by the type of curing medium.

Glass.

Types. Students should become familiar with the properties and applications of the common glasses: soda-lime, borosilicate, lead-alkali and high silica.

Thermal tempering. Soda-lime plate glass can be given a heat treatment known as tempering, which increases the strength of the glass by about four times.

The glass specimen is heated to the softening point and then quenched in a cool air blast to produce a compressive stress in the skin of the glass. The strength increase can be demonstrated using the bending or three-point loading test.

Chemical resistance. Glass is known for its chemical inertness. However, hydrofluoric acid will attack the silicates in glass. If a soda-lime or borosilicate (Pyrex) glass test tube is half-filled with HF, the acid will dissolve the walls of the tube after several days.

Conclusion. Space and time limitations have permitted only a representative sampling of experiments to be included in this paper. If you or one of your colleagues should wish further information in the materials area, do write for assistance. The address is 3750 Willingdon Avenue, Burnaby 2, B.C., Canada.

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The future of the materials engineer

David W. Guerdat

Introduction. Man's interest in manufacturing materials is not new. He has used them in one form or another for as long as he has existed.

The evolutionary changes, from the Stone Age to the Bronze Age to the Iron Age and into the industrial revolutions, added many complexities to man's working environment. It has been said, however, that none of these revolutionary changes have compared with the most recent technological revolution, "The Materials Age". This is the age in which man tailor-makes materials for his mechanisms in terms of their particular working environment.

What is a materials engineer? The answer comes hard because the acceptance of materials science and engineering as industrial tools worthy of separate attention is relatively new. Truthfully, the discipline which encompasses materials science and engineering and technology is in a state of transition. And transition implies that materials engineering functions, responsibilities and opportunities may not be clear in many companies, that the goals of existing or potential materials engineers may not be as well established as, let's say, those of mechanical engineers or designers. Probably, the function of the materials engineer, in a company where materials and manufacturing costs amount to a large portion of sales dollars, can be listed in this manner:

(1) Evaluation and selection of materials
(2) Initiation of materials and processing changes
(3) Development and modification of materials
(4) Solution of manufacturing problems involving materials and processing
(5) Preparation of materials and processing specifications
(6) Correction, organization and communication of materials data
(7) Liaison with vendors.

The materials engineering manpower gap. Scarcity characterizes engineering manpower in all disciplines as industry enters the 1970's. The gap between the number of engineers in all disciplines as well as materials engineers required by industry and the engineers available is both significant and ominous.

We are all aware that more and more young men and women are entering college each year, and this number increases not only with the population increase but also expands as a higher proportion of the age group seek higher education each year. But over the past decade, as we became more and more dependent on science and technology in our society, a smaller and smaller proportion of these men and women elected to become scientists and engineers. For example, between the period of 1950 to 1968, engineering baccalaureates fell from 13% of the total of all bachelor's degrees granted to 5.5%. Even in actual numbers, our yearly supply of bachelor's degrees for young engineers is not rising. In 1950 (the peak production year), almost 53,000 engineers were graduated from United States colleges and universities. In 1969, fewer than 40,000 were graduated. As a matter of fact, we have produced fewer than 40,000 engineers each year since 1952, while the total number of bachelor's degrees more than doubled, rising from 332,000 in 1952 to 749,000 in 1969.

The shortage of trained engineers at the municipal level already has been termed "catastrophe" by some city officials. Positions for engineers in many companies remain vacant. More than 900 employers surveyed by Engineers Joint Council in 1969 reported that they fell 25% short of their planned recruiting goals for new engineering graduates.

Rather than improving, that manpower shortage in engineering will continue to worsen. Despite the need for new engineers, estimated at 69,000 annually for the next decade, engineering schools currently are only graduating half that number. While these vacancies are filled by competent individuals, substantial training expenditures are required to make up for the lack of engineering education. While individual companies feel the direct results of engineering manpower gap, the situation becomes even more critical when viewed at the level of international technological competition. More than 200,000 engineers and scientists graduated in Japan in 1966. Russian technical schools graduate an estimated 138,000 engineers annually. The impact of this emphasis on engineering education abroad may already be seen in the increasing competition for both domestic and Free World technical markets.

Looking toward the future, it would appear that we have two choices – to continue to improve our technology by increasing the proportion of our young people trained in these fields, or to try to move away from our technologically-oriented society, to which we have become accustomed. This latter solution seems not only improbable, but unreasonable. We will not de-pollute our environment by keeping from use the advantages of our present technical capability. We must instead turn our faces forward, seeking new advances in technology to improve the problems of the early advances, while at the same time moving forward with new discoveries which will in turn create new problems that will have to be solved.

Those of us who would like to invite our wonderfully idealistic, marvelously talented young people into the challenging world of materials science and engineering face some obstacles. Perhaps the most immediate one is to convince young people still in high school that science and engineering do not produce war – although some of the discoveries and inventions of science and engineering have been used to wage war. They do not in themselves produce pollution – although pollution has resulted when technology was put to work without the necessary (and expensive) safeguards. Perhaps an almost equal obstacle to convincing today's young men and women, and particularly their parents, that materials science and engineering are wonderful fields is created by today's uneasy stories about engineers having trouble finding jobs. It should be our job to point out that this unhappy temporary situation should not be viewed as a long-range phenomenon. It is instead the inevitable result of government gearshifting as we move away from one set of priorities and yet have not moved into another – in today's case, away from a war in Asia and toward peace with our environment. The shifting process in itself is always painful to those caught in the transition because they are pursuing activities we are learning from. But it is important that we do not let our vision of the long road ahead be blocked by this temporary obstacle.

It is important in our looking ahead to note that in 1990 we will have almost exactly the same number of young men and women reaching the college graduation age of 22 that we have today. These potential college graduates of 1990 already have been born, and we know their number, but our total population in 1990 will have grown more than 1/3 larger than it is today.

It is vital then that we encourage and help today's high school student who is interested and capable of being a part of the exciting world of materials science and engineering, for without their mature leadership in 1990, we have no hope of meeting the technological needs of the new century.

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Materials concepts in industrial arts

Louie Melo

Industrial arts philosophy. For many years problem-solving has been identified as an important part of a dynamic industrial arts program. A 1968 AIAA brochure described industrial arts as that phase of the educational structure that helps students, through the use of applied science and technology, more realistically to understand the theoretical as well as the practical operations of modern industry. These blocks of study are said to be the fundamentals of our technological society.

If we scrutinized the pro's and con's related to industrial arts philosophy, we would learn that most professional and business people concur that this discipline can contribute in providing important fundamental technological concepts as a part of our educational offerings.

Industrial arts realities. While industrial arts philosophy presents a favorable educational potential, we must also admit that a realistic review of industrial arts in practice still portrays numerous programs as being dedicated almost exclusively to skill development. As a result, such observed methodology is often branded as "manual training" rather than as "technological education".

In spite of such observed shortcomings, the truly dedicated educator has been working toward upgrading his offerings and still believes that industrial arts can and must strive to meet its philosophical objectives and thus portray itself as an effective, integral part of the modern educational system. To accomplish its established goals, educators at all levels must structure their course content to permit teachers and students to probe beyond the "what to do" and "how to do it" levels of operation. Probing and discussing the relevant "technological and/or scientific why" seems to be an educationally lucrative arm of a well-structured industrial arts program.

Such a broadly developed course of study, that encompasses and integrates the relevant "why" story when discussing the observed chemical, physical and/or mechanical changes or reactions of the materials he uses, would provide added direction as well as a point of departure for the future engineer, technologist, technician and other technologically-oriented students.

Innovative programs. During more recent years, some rather comprehensive innovative programs have been introduced in various parts of the nation. Their success toward modifying, restructuring and widely promoting meaningful laboratory innovations is still rather small. Nevertheless, the fact that concerned educators are questioning their respective offerings does point toward bringing the total educational offerings into tune with educational needs. For example, it was very gratifying to review one such proposed program, by the Public Schools of the District of Columbia, developed cooperatively by the directors of their Science and Industrial Arts Departments. These educators are striving to develop a composite program that will permit the probing and discussing of relevant technological and scientific phenomena. Programs of this nature will truly promote problem-solving experinces related to many aspects of design, material selection and review, processes and products of industry. It would likewise incorporate meaningful applications of the principles of applied science, mathematics, technological communication and other related subject matter.

Industrial environment - A counterpart. A review of the working structure of modern industrial organizations would reveal that a number of departments cooperate and coordinate their individual efforts toward the basic objectives identified by the establishment. These often include the design, development and manufacture of products that must perform satisfactorily in a given environment.

A dynamic organization will include departments that are interwoven and interlaced, often involving pure research, applied research and various levels of engineering and/or technological operations. All of these become the backbone of the industrial organization and cooperatively play a very important role by employing phases of applied science and technology to solve their selected problems.

Materials – A significant phase

The importance, breadth, role and complexity of modern materials has been identified as our most recent major technological revolution. It has also been said that the "Materials Age" is the age in which man may be called upon to tailor-make materials to work within a particular environment.

To understand and work effectively in a modern industrial environment, it is extremely important that the practitioner (in education or industry) develop significant insight into the science of modern materials. The era of being concerned only with observable forming, shaping, blending and/or joining problems has given way to the inclusion of a more comprehensive study of the materials in terms of their microscopic and macroscopic structure and working characteristics in addition to their expected performance.

Even though our industrial complexes are still strongly dependent upon various metals with alloyed blends in excess of 25,000, other materials, such as polymers (resins and/or plastics), adhesives (bonding agents of all kinds), ceramics, coatings, fuels, lubricants, wood products, etc., have over the year experienced equally phenomenal growth. In each of these industrial materials fields, their introduction progressed from the use of natural substances to the development of many modified and/or synthetic materials to meet the ever-increasing demands of our modern world. Thus, the modern technologist can now reach into his materials pool for special substances that will render predetermined services as never before in history.

Materials selection. An understanding of the materials being considered and ultimately selected is a very significant part of a modern industrial organization. Departments charged with this responsibility devote considerable time toward the selection of appropriate materials to assure satisfactory product performance when exposed to its varying working environments. Several articles on "How Materials are Selected", by H. Clauser, R. Fabian and J. Mock, in Materials in Design Engineering, July, 1965, present a very excellent and meaningful pattern from "concept formulation to manufacturing". These presentations should be of interest to industrial educators and should be reviewed in detail. A few fragments from the Materials in Design Engineering articles will provide some reinforcing insight:

> Like most engineering efforts, material selection is a problem-solving process. Much has been written on problem solving, and the major steps involved have been expressed and defined in many different ways. However, there is a general agreement that the major steps are:
>
> (1) Analysis of the problem
> (2) Formulation of alternate solution
> (3) Evaluation of the alternate
> (4) Decision
>
> When these are applied to the material selection process, the steps become:
>
> (1) Analysis of the material requirements
> (2) Selection of candidate materials
> (3) Evaluation of candidates
> (4) Selection of the candidate material that best meets the requirements.

This writer suggests that since a review and understanding of selected pure and modified substances are an important phase of modern industry, they should, in like manner, become an equally important and integrated part of the industrial arts curriculum offerings.

Moving from project design to project manufacturing, employing readily-available material at hand, is, at best, poor practice. Such laboratory patterns leave little or no time for the necessary and important series of meaningful educational sessions designed to bring into focus the relevant variables that materials display when subjected to their various operational environments.

Tomorrow's environment. Time and space will not permit us to explore all the avenues that tomorrow's industrial practitioner and educator may have to understand and help solve. A number of articles are currently being published that speculate with their readers on the possible technological changes during the '70's and on to the year 2000. A few observations that may be of interest to the educational planner are presented below:

(1) A much closer marriage between science and technology is expected to create a team effort that can make almost anything possible.

(2) By the year 2000, industrial activities and involvements are expected to increase threefold.

(3) Our waste and pollution problems will generate some very strong industrial and educational driving forces toward solutions. Modern materials of all kinds will be a part of this problem. A few examples, as food for thought, are presented:

Part of our yearly waste problem is said to include -
46 billion food and beverage cans
48 billion glass and plastic bottles
100 million automobile tires
6 million automobiles
Millions of tons of paper products
--and the list goes on and on--

In addition, nearly 15% of the fossil fuels (liquids and solids) that are used for all purposes are discharged into the environment in their raw, semi-burned or semi-chemically-altered state.

(4) The drive toward reducing air pollution will also generate a drive toward the development of many new organic and inorganic non-hydro-carbon-solvent-carrying coatings, to be deposited at their respective vapor temperatures to help solve new protective and decorative problems.

(5) Steel making will have improved to a point that 500,000 psi strengths will become a reality. We are already reading about super plastic metals that can actually be blow-molded into new shapes.

(6) Metals displaying nearly 100% memory shape-recovery with strain stresses of over 50,000 psi are a reality.

(7) The powdered metal industry, introducing innovative power and sintering methods, is expected to open many new additional metal fabricating avenues.

(8) The polymer industry is already expanding its material horizon by introducing polymer alloying and more extensive use of filler and/or reinforcement additives.

(9) Modern adhesive materials are now receiving considerable attention as they are helping to solve many industrial fastening problems, another growing concern for tomorrow's educator.

(10) Nuclear power, as one of man's power sources, now at about 1%, is expected to exceed 20% by 1980. If we consider future power growth, generation of nuclear energy by the year 2000 will be expected to represent an energy output greater than all the 1955 power sources combined. Again, what role must the technologist and educator assume as this new giant grows in our midst?

-- and the list can go on and on --

Tomorrow's industrial education student. Thus far we have tried to review a few fragments of what the student of tomorrow must cope with. If tomorrow's industrial arts classroom is to reflect the technological problems of the day, its teachers must understand and accept that no single department or offering of the educational environment can stand alone, just as no single part of an industrial establishment can survive or progress without the help and cooperation of other segments of the organization. Therefore, co-operative team effort, integration, collective action, coordination, or call it what you will, must become a functional part of the modern educational establishment.

Thus, all of us who are members of the technological team, regardless of our particular role (students, teachers at all levels, or industrial practitioners), must accept a basic premise: that the numerous materials we work with, and the many operations we, or our people, discuss, teach or perform, will include some communication, scientific, mathematical and technological blocks of data that are an integral part of the total industrial environment.

This is why *this writer strongly suggests that educators teaching communication, mathematics, science and technology should strive to develop stronger interwoven or inter-twined teams toward helping young people better understand their technological world*.

A final thought. This writer did present the problems of the future and some of the numerous implications to a group of graduate teachers. Several key points of their deliberations are presented.

The world of tomorrow needs the flexible man, the intelligently mobile man, the man who can land on his feet when his job becomes technologically obsolete. To educate for flexibility, we must distinguish between training and *education*.

To *train* is to emphasize fixed responses: to stress immediate goals which often have a low ceiling of possible growth. This is possibly the only way to help the person who has limited reasoning capabilities; however, even here, his material should not be presented as a closed loop circuit. The doors toward even limited reasoning should always be kept open.

To educate, however, is to foster limitless growth and life-long learning. This is the most fertile ground for tomorrow's educator. Thus, if the educator is concerned with the broader spectrum of education, it appears to this writer that the student should be encouraged to look for and talk about the "why" behind every "what" and "how" when involved in classroom or laboratory activity. In many ways, he must strive to develop a more meaningful bridge between the broad dynamics of industrial problems and the industrial arts classroom.

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Metallurgy in junior high school industrial arts

Lorin V. Waitkus

No other industrial material has made such a tremendous contribution to the advancement of technology as metal. Approximately two-thirds of the known chemical elements are metals. Metals have been so important that certain periods in history have been given names, such as the Bronze Age and the Iron Age. The metals possess numerous physical, mechanical and chemical properties. It is difficult to generalize about metals, since many exceptions can be cited. For example, most metals have the ability to conduct heat, but manganese is a very poor conductor; most metals can be formed without breaking, but bismuth will shatter if struck by a hammer.

Metals are versatile materials. Here are some of the ranges of properties:

(1) Melting point fron -37°F for mercury to 6170°F for tungsten.
(2) Densities from 0.06 lb/cu.in. for magnesium to 0.77 lb/cu.in. for platinum.
(3) Coefficients of expansion from 2.55 for lead to 22 for zinc.
(4) Thermal conductivity from 0.020 for bismuth to 0.949 for copper.
(5) Moduli of elasticity in tension from 2 for lead to 67 for rhenium.
(6) Cost from a few cents a pound for iron to $35.00 an ounce for gold. (And even higher for rare metals.)
(7) Ductilities from the very low values for carbon steels at cryogenic temperatures to very high elongations for aluminum and stainless steel under the same conditions.

Metals can be shaped by almost any known method: cast, forged, rolled, drawn, extruded, coined, machined, etc. They can be plated, coated, polished or etched. They can be welded, brazed, diffusion-bonded, adhesively-bonded or mechanically-fastened. (3:4-5)

Metal working is the largest industry in the country, accounting for nearly half of all manufacturing activities. In value added by manufacture, metalworking is four times larger than the food industry and twelve times larger than the apparel industry. Metalworking sales in 1954 amounted to $115 billion; in 1963 the figure was $182 billion. By 1980 metalworking sales will exceed $300 billion.

The advancements in manufacturing depend upon the special properties of metals and on the ease with which metals can be brought into final shape. Bringing the metals or materials into final shape in response to man's wants for goods is part of the dominion of industrial arts education.

We in industrial arts education generally recognize the importance of metallurgy, but finding consistent support for the learning effort is often a problem. Every branch of man's work or technology is greatly expanding. The advancements no one will deny; the difficulty lies in assessing the changes, because they are so rapid.

There are many developments in industry that effect change in industrial arts education. Two important influences on industrial arts education as a result of the rapidly-changing industrial technology are:

(1) Manufacturing complexity keeps advancing the state-of-the-art or the technology.
(2) Because of the complexity of development, magnitude of specialization is important.

These two effects of modern technology are pointed out in order that what may be done in industrial arts education will be valid in relation to modern technological developments. Let us consider these two influences briefly.

First, manufacturing complexity keeps advancing the state-of-the-art or the technology. Allen G. Gray, editor of Metal Progress, comments that "many of the significant gains ahead may depend more on the proper use of materials than on manufacturing methods."(6:53) Today's complex machines, systems and automated lines demonstrate that man can shape his destiny with technology and need not leave it to chance.

Technology forecasts of the 1970's reveal methods that conserve metal and labor. There will be much activity in chipless machining, especially in the rolling of gears. This will result from the inflationary trend in wages. Metal shortages will also add to the attractiveness of chipless machining. Much nickel is wasted in machining at the present time. If cobalt, chromium, vanadium, molybdenum or tungsten becomes scarce, chipless machining will become even more attractive.

Powder metallurgy will gain because of efforts decreasing chip-making. The desire for parts to possess better properties will be realized, because of more and better compressible powders and higher compressing pressures.

Advances in friction welding promise to save weight by eliminating overlapping edges and the need for mechanical fasteners. Expect more automation of operations and processes for heat treating. Shops will insist on smaller furnaces that can be easily integrated into processing and grinding lines.

Eliminating the human element is the trend in testing and inspection. Nondestructive testing, combined with automation, will bring about 100% inspection. Nondestructive testing will be important to the nuclear industry, because quality must be assured before the product goes into service.

Wayne E. Grimm, director of the Chrysler Institute of Engineering, relates that "technical knowledge doubles every ten years. Half of what the scientist or engineer of 1975 will need to know isn't even yet available. Half of what he knows now will be inapplicable in ten years." (7:2-3) Metallurgy, the case in point, has barely scratched the surface of possibilities. "Over 70 of the 98 natural elements are metals, yet less than one-half of the 70 metals are in commercial use today."(4:3)

Second, because of the complexity of developments, magnitude of specialization is important. This does not simply mean choosing something special to do. It does mean choosing a specialty as a center for integrating ideas and activities. Known processing techniques can increase efficiency and productivity. Many times, important techniques needed are unknown to those responsible for coordinating processing applications.

Roger W. Bolz, president of Automation for Industry, Inc., states that "freedom from the restrictions of the usually limited number of known methods can effect amazing advances in quality, efficiency and profitability. All too many known techniques are all but unknown outside a small circle of familiar operations."(2:57)

A new giant of industry is the knowledge worker. This person applies himself to solving a problem, rather than to getting to the top in an organization. The knowledge worker scrambles traditional organization charts. He is an individual of cross-disciplines who can make sense out of the chaos by properly assessing changes that are occurring rapidly. This kind of specialist provides the thrust to planning. He is the master of the new technology. US Labor Department projections reveal that metalworking will draw more and more on knowledge workers. While occupational groups also will increase, projected manpower increases reveal that the professional and technical workers will increase the most. Not only will manpower changes shift, but also the college degree awards in science will take on a new rank. (1:99-103)

Along with the change in the nature of the individual's function, there will be a change in the structure of the industrial organization. The individual will be in close contact with other specialists. He will need to understand and help solve problems now almost out of his area of specialization.

> The social structure of organizations of the future will have some unique characteristics. The key word will be 'temporary'; there will be adaptive, rapidly changing temporary systems. These will be 'task forces' organized around problems-to-be-solved. The problems will be solved by groups of relative strangers who represent a set of diverse professional skills. The group will be arranged on organic rather than mechanical models; they will evolve in response to a problem rather than to programmed role expectations.
>
> Adaptive, problem-solving, temporary systems of diverse specialists, linked together by coordinating and task-evaluating specialists in an organic flux. . . .(8:6) —

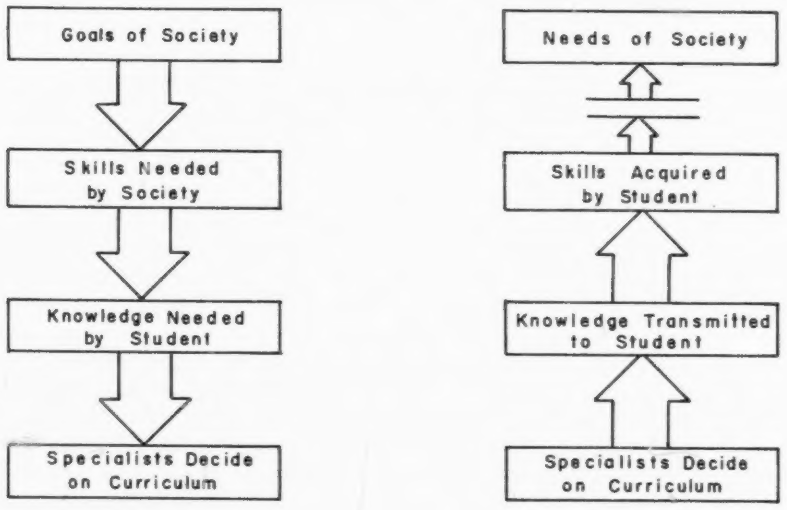
this will replace the industrial organization as we know it.

Specialization thus becomes a center of integration of various industrial processes.

Performance of wider functions requires a new range of skills for closer interaction with other functions. This means combining a particular specialization and a general understanding of the whole industrial system.

Planning and organizing a curriculum in terms of these two important factors suggest a system of human technological relationships. Many industrial arts courses are systems which mold an individual who is continually in confrontation with a rapidly changing society. (See Figure 1.) The curriculum specialist selects a set of knowledges and skills, which then are transmitted to the student. When education follows this system, the student soon finds that his learning does not match the needs of society. (9:362) There is a gap between what the system produces and what society needs.

AN APPROACH TO INDUSTRIAL ARTS
EDUCATION


Goals of Society
Skills Needed by Society
Knowledge Needed by Student
Specialists Decide on Curriculum
Needs of Society
Skills Acquired by Student
Knowledge Transmitted to Student
Specialists Decide on Curriculum

Proposed Plan for Education

Traditional Education

FIGURE I

By altering the basis of curriculum planning, a better system of education can be achieved. The goals of society indicate the skills that society needs. This suggests knowledge needed by the individual; then curriculum specialists can decide on a system of education. With education based on the goals of society, the student will be prepared to live comfortably in a rapidly-changing technological world. There must be a close connection between industrial arts education and individual development. The intent is not to produce more participants in industry, but to produce more creative, productive participants in industrial technology. For example, an industrial arts program should go beyond the teaching of isolated techniques when these techniques really form interrelated entities or holistic systems.

Industrial arts is essentially considered to include those management, personnel and production techniques used to construct and manufacture goods. (10:155) Metallurgy is of major importance in the processing of many material goods. Knowledge of the techniques of metallurgy often permeates management, personnel and production practices in the manufacture of these products.

Metallurgy in a junior high school industrial arts course does not preclude the study of management, personnel or production practices. For example, students at Roosevelt Junior High used metallurgical testing equipment to study metals and their properties in various manufacturing processes.

Manufacturing substantially changes the form of material to satisfy man's wants for goods. As man increases his knowledge of techniques and tools, more elaborate materials are required to meet his wants and his needs.

Metallurgy embraces the production of materials and the use of materials. In planning an industrial arts course, we should draw heavily on the knowledge of using the materials. (See Figure 2.) In the category of using the materials, knowledge can be organized around two concepts: processes and products. Processing consists of forming, separating

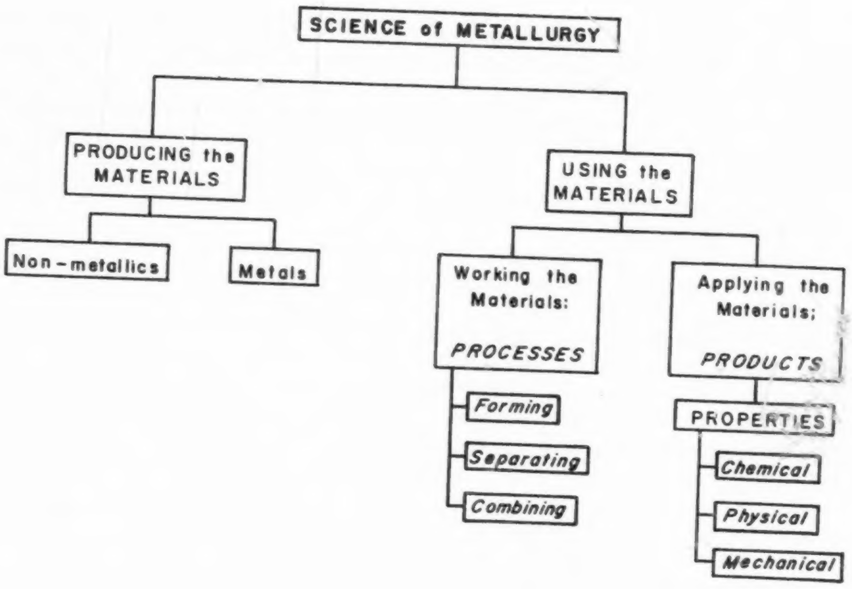


FIGURE 2

and combining. Products possess properties of three kinds: chemical, physical and mechanical.

An industrial arts course is concerned with materials, processes that change the form of materials, and the products that result.

Using these three factors--material, processes and products--a matrix or model has been devised to show the interrelationship of metallurgical techniques to industrial arts. Incidentally, this interrelationship of ideas makes industrial arts more exciting and presents many opportunities and challenges for students of different temperament.

The model reveals the sub-elements of materials, processes and properties. The knowledge of metallurgy is used in understanding (1) the materials, particularly the metals, (2) the processes of forming, separating and combining as accomplished in manufacturing, and (3) the properties classified as mechanical, physical and chemical.

Each axis of the model can be studied as a source of discrete information. However, a more suitable approach can be taken at this level. The interrelationship of metals and their properties to manufacturing processes discloses a knowledge of how to produce industrial goods efficiently. This model can become the means of integrating various industrial processes, and it provides a structure for "efficient" production practices. In using the model, a metal can be selected because it possesses certain properties that will affect the performances of the product. For example, mechanical properties such as required strength, hardness, toughness and plasticity can be built into products manufactured from aluminum, steel, cast iron, or whatever, by using appropriate processes. The complexity of the problem is evident with the interrelationship of the sub-elements of the three axes.

Educational experiences can be related and assessed within the framework of the system of technology. Dr. Duke made the statement at the ASM Materials Engineering Congress and Exposition in Philadelphia in 1969: "Not only must the material provide the required properties, and not only must the material and process produce the required shape, but the material and process must be compatible. One must not overlook the fact that the shaping process also contributes to final properties." (5:80) One approach to metals is looking at the whole problem, rather than examining discrete parts.

The proposed model offers a holistic approach to specialization in industrial knowledge, without narrowing the field of vision at this level.

This model was developed by the presenter last year to build a curriculum revealing the interrelationship of metals and their properties to manufacturing processes. The curriculum innovation was used in two ninth-grade industrial arts classes. The model provided an integrated structure for studying efficient production practices.

While studying the whole system of relevant efficient production practices, the ninth-grade industrial arts students learned a number of special skills. They prepared metallographic samples in four steps: Mounting the specimen, grinding the specimen, polishing the specimen and etching the specimen.

Then they observed the specimen with a metallurgical microscope. Sketches or micrographs were made of all metals observed by microscope. Sometimes photomicrographs of various metals specimens were taken with a Polaroid attachment. Mechanical properties were investigated on testing equipment by performing tensile-strength tests, hardness tests and toughness tests.

Students presented their findings and demonstrated industrial applications of metallurgical techniques. Topics included: Altering crystalline structures by regulating heat, recalescence in stell, heat treatment of metals and effect of cold working on metals.

Students worked individually or collectively, each prepared written and oral reports, and performed various industrial processes suited to their interest level and ability.

The study units are centered on providing material goods using techniques of metallurgy. The units provide an understanding of metals, properties and processes and of how these interrelationships aid man in solving production problems.

In selecting a problem, students (1) determine goals, (2) research the problem and (3) design a solution.

Greater student participation and motivation occur when students help determine learning experiences and select goals within the framework or system of industrial arts education. Meaning exists in the person and not in the word or thing.

After the goal has been determined, the next step is researching. Students seek information from industries, groups, individuals, libraries, and from any other source which may provide pertinent data. Many technical reports, research reports, NASA bulletins and trade journals provide information in metallurgy. Industries and testing laboratories can provide information, consultants and sample materials for industrial arts classes.

Designing involves selection of processes and materials to meet specific properties. For example, in one problem, powdered copper was selected as the metal to be compacted into bushings, since copper possessed the properties that the product required. Properties of material are important design considerations.

Prototypes of tools, dies, presses or machines can be assembled and tested. Students evaluate the problems of industrial production, using the model elements: material, processes and properties.

Metallurgy always will be an essential part of industrial arts education. As new processing techniques become less and less like traditional techniques, and the properties of advanced alloys and traditional alloys diverge, metals will still be the foundation of modern industry.

Knowledge of metallurgy can increase the efficiency of management and processing practices. Knowledge of metallurgy provides the skill needed to select the right material for the product.

To utilize the properties of modern metals, such as berylium, zirconium and titanium, to mention but a few, requires individuals with intimate knowledge of the characteristics of those metals and of newer processing techniques.

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The metal casting industry today

Harold W. Ruf

The earliest known castings were made around 4500-4000 BC in the area now known as Iran and Iraq. The first observed casting probably resulted from molten metal solidifying in crevices or depressions in the adjoining ground near fires fanned by strong winds. This later led to the making of crude clay and stone molds.

Because of its low melting point, widespread occurrence and availability in the metallic state, copper was the first metal cast. By 3000 BC the process had developed to a considerable degree.

Until the beginning of the Industrial Revolution, the practice remained a craft or art, generally limited to the production of single items ranging in size from pieces of jewelry to boat anchors. Large quantities of single shape were only produced in the form of bullets, cannon balls and similar projectiles used in warfare.

The Industrial Revolution created a need for larger quantities of castings for the production of industrial and agricultural machinery. But the ancient technology was not changed greatly and, with a few exceptions, casting shops or "foundries" were still small, privately-owned and -managed organizations, employing a small group of craftsmen.

This situation began to change with the introduction of the internal combustion engine, electric motor and the other inventions that led to creation of a mass consumer market. And the situation is continuing to change today. But unfortunately, all too often the foundry industry is still thought of by many people as a number of small shops operating in dingy, poorly-lighted buildings on some side street. A tour of any one of a number of modern foundries, and consideration of some pertinent figures that I will present today, should convince anyone that this is no longer an accurate description.

The industry is distributed throughout the United States and consists of a variety of plant sizes from the very small to the very large. A small company often gives an individual the opportunity of ownership, if that is his desire. A large company can give the opportunity for specialization within a narrow range, if that is desired.

Foundries are classified many ways: For example, by the type of metal poured, such as gray iron, steel, copper-base alloys, magnesium, aluminum ductile iron and, I suppose, even gold and silver. Foundries are also typed as to "jobbing" or "captive".

Another classification is by the types of mold used, such as permanent molds, conventional green sand molds, shell molds, plaster molds, ceramic molds, cement molds and others.

The steel railroad car wheel foundry, producing castings in graphite molds, differs greatly from a high alloy foundry using the "lost wax" process. Similarly, the foundry producing castings in green sand molds has operations far different from those of the pipe foundry producing castings by the centrifugal process.

The various types of foundries have one thing in common, however, namely, that they form molten metal into a predetermined shape which on solidification becomes a useful product.

Every two years Foundry magazine compiles data furnished by the Bureau of Census and others, and publishes it in a booklet called "Metal Castings – A Mighty Market on the Move". I would now like to present some of this data.

The data tabulated in Table I shows that, currently, metal casting is the sixth largest industry in the country when based on "value added by manufacturing". "Value added" is the increase in value between the time the raw material is received at the plant and the time the product is shipped from the plant. For an industry to rank sixth in the nation

TABLE I

RANK AMONG TOP MANUFACTURING INDUSTRIES

Rank	Industry	1967 Value Added By Manufacturer
1	Motor vehicles and equipment	$ 14,266,000,000
2	Aircraft and parts	11,602,000,000
3	Blast furnaces and steel mills	10,424,000,000
4	Basic chemicals	7,685,000,000
5	Communication equipment	6,913,000,000
6	FOUNDRIES (including captive plants)	6,188,000,000
7	Metalworking machinery & equipment	5,154,000,000
8	Beverage industries	4,848,000,000
9	Petroleum refining	4,685,000,000
10	Electronic components	4,517,000,000

Source: US Department of Commerce
1967 Census of Manufacturers

certainly does not imply small shops on side streets. Quite the contrary. To attain this position, the operations must be substantial. In 1967 a total of 5,395 foundries were operating in the US and Canada. These companies employed 477,729 people and had a total annual capacity of 31,503,448 tons of castings.

TABLE II

1966 CASTING PRODUCTION

	Net Tons*	Dollar Value**
Gray and ductile iron . .	15,716,000	$4,432,000,000
Malleable iron	1,132,000	788,000,000
Steel	2,156,000	1,526,000,000
Nonferrous metals	1,836,000	3,187,000,000
Total Production	20,840,000	$9,933,000,000

Source: *U. S. Bureau of the Census.
**Estimated by FOUNDRY based on U. S. Department of Commerce data.

The data in Table II classifies 1966 casting production according to type of metal. You will note that gray and ductile iron production led in tonnage, with a total of 15,716,000 tons. This was followed by steel castings with 2,156,000 tons. Nonferrous production, including aluminum, magnesium and copper-base metals, accounted for 1,836,000 tons and malleable iron 1,132,000 tons.

Due to the lower density of the nonferrous metals, variations in price of different raw materials, type of end product and many other factors, it is not accurate to compare production on the basis of weight alone. Dollar value must also be considered. The figures based on this unit of measure show a closer grouping of the different segments of the industry than did the figures based on tonnage. The estimated combined sales value of the products of this industry in the US during 1969 was in the neighborhood of twelve billion dollars – again, no small figure.

The report shows further that castings are produced in 49 out of the 50 states. The concentration of plants naturally is in the states that have the greatest amount of manufacturing.

In Table III we see a classification of foundries according to size, as measured by number of employees. Foundries producing gray and ductile iron lead in total number and in number employing more than 100 people, just as they lead in tonnage. On a percentage basis, both malleable and steel foundries tend to have a larger average employment than do the gray iron shops.

Now let us look at the recent historical trend of the size and employment figures. Table IV presents a review of the number of plants of each size, operating during the odd-numbered years since 1961. You will note that there has been a gradual decrease in the total number of foundries in operation, going from 5,879 in 1961 to 5,395 in 1967. The

TABLE III

NUMBER OF FOUNDRIES BY SIZE AND PRINCIPAL METAL CAST
United States and Canada—1967

FOUNDRIES EMPLOYING	BY PRINCIPAL METAL CAST				TOTAL FOUNDRIES
	Gray & Ductile	Malleable	Steel	Nonferrous	
Over 1,000	29	5	9	6	49
500-999	42	15	33	19	109
250-499	93	20	56	54	223
100-249	290	31	106	166	593
50-99	411	8	59	310	788
20-49	428	1	70	656	1,155
Under 20	431	—	60	1,987	2,478
TOTAL	1,724	80	393	3,198	5,395

main numerical decrease occurred in the number of plants that employed fewer than 50 people. In fact, the number of plants employing more than 50 people increased during that time.

In part, the decrease in number of smaller shops may be due to the fact that some of the more progressive, well-operated, small foundries expanded during this time and thus moved into the higher bracket. More often, the small shops were not able to remain competitive because of their inability to produce sufficient capital for the modernization necessary for them to produce the higher quality, larger quantities and lower costs required in today's competitive market. There is a feeling among knowledgeable people that this trend toward fewer small foundries will continue in the future. One point here stands out: The castings industry in 1970 produces more and better castings with fewer plants than in 1960.

Next let's look at the types of end product in which metal castings are found. The next three tables (Table 5, 6 and 7) list the major users of castings according to tonnage and application. These figures show that certain industries are by far the largest users – motor vehicles of different types using the largest weight of iron castings and the railroad industry making use of the largest weight of steel castings. But castings find successful application in a wide range of industries. And a small percentage does not necessarily mean a major application. With that estimated total sixteen million tons of gray and ductile iron castings produced last year, even 1% of the market amounted to one-hundred-sixty thousand tons of product.

TABLE IV

ANALYSIS OF THE FOUNDRY INDUSTRY

(Number of plants, U.S. and Canada)

By Employment	1967	1965	1963	1961
Over 1,000	49	37	28	28
500 to 999	109	82	81	86
250 to 499	223	191	195	212
100 to 249	593	547	533	540
50 to 99	788	701	728	741
20 to 49	1,155	1,195	1,211	1,216
Under 20	2,478	2,729	2,898	3,056
By Major Metal Cast:				
Gray and ductile iron	1,724	1,771	1,896	2,040
Malleable iron	80	83	90	92
Steel	393	370	367	360
Nonferrous metals	3,198	3,258	3,321	3,387
By Jobbing-Captive:				
Exclusively jobbing	3,510	3,559	3,577	3,631
Primarily jobbing	580	555	610	696
Exclusively captive	870	930	975	1,010
Primarily captive	435	438	512	542
ALL PLANTS	**5,395**	**5,482**	**5,674**	**5,879**

So we're big and we're growing and the magnitude of an individual plant's operation is typically increasing. All this is happening because there is a growing need for our product, coupled with a continuing demand for a consistent, reliable product at a price competitive with other methods of producing the same part.

As educators, I know you are not interested in only the economic stability and profit potential of the casting industry. I'm sure you're concerned to an even greater degree with its "potential for people".

The casting industry is like any other manufacturing industry – whether it be a milk plant, steel mill, furniture factory, paper mill or brick yard – in that it must have employees using the plant facilities to convert raw material into a product that is in demand by its customers.

These employees may be directly involved in production of the product or in any one of several other areas – the Purchasing Department, Personnel Department, Sales Department, Maintenance Department or the Accounting Department, to name a few. A recent analysis of a typical medium-sized foundry indicated that about 68% of the employees were in production jobs. The remaining 32% could be classified as managerial, financial, sales or technical.

Today, with the presence of sophisticated automatic equipment, job responsibilities have changed and will continue to change. At one time, when most people thought of a foundry, they thought of a molder, just as they thought of a baker in connection with a bakery. In today's production foundries, or bakeries, such men are in a minority. In the survey just mentioned, only 6% of the employees were listed as molders. The large automotive foundries built in recent years do not employ any molders. Their job title for a man producing molds is "machine operator".

Similar changes have taken place in the other production departments of our plants. Not long ago one of our plants had 18 skilled bench core makers, producing cores in the oil sand process. Today the same production requirements are met by four operators, each running two semi-automatic blowers in the shell core process. The cores are stronger and of greater dimensional accuracy, and they are ready to be used right now, with no further delay for baking in an oven.

These and other changes do not mean, however, that our production people do not need training for their jobs. An introduction to all phases of foundry production makes a man more valuable in any area to which he is finally assigned. If the man mixing our molding sand has had first-hand acquaintance with drawing a pattern from a mold, he will understand the results of either a sticky or dry sand. So he will more readily realize the need for accurate measurement of the materials added.

And the man pouring metal into a mold has to understand that he's doing more than just filling up a hole. If in his previous training he has experienced the frustration of making and pouring a mold, only to find that his casting is incomplete because the metal was too cold or poured too slow, that lesson will stay with him for a long time. It's this kind of experience you men are giving your students at the "grass-roots" level. And it's of utmost importance that you do so.

TABLE V

GRAY AND DUCTILE IRON CASTINGS

Rank	SIC Code	Industry	Per Cent of Total
1.	3717	Motor vehicles and parts	31.4
2.	3522	Farm machinery and equipment	8.3
3.	3494	Valves and pipe fittings	3.9
4.	3519	Internal combustion engines	3.1
5.	3561	Pumps and compressors	3.0
6.	3531	Construction machinery	2.9
7.	3431	Plumbing fixtures	2.6
8.	3433	Heating equipment, except electric	2.2
9.	3541	Metal-cutting machine tools	1.8
10.	3585	Refrigeration machinery	1.6
11.	3566	Power transmission equipment	1.5
12.	3443	Boiler shop products	1.5
13.	3621	Motors and generators	1.1
14.	3554	Paper industries machinery	1.1
15.	3429	Hardware, not elsewhere classified	1.0
		All other industries	33.0

1966 estimate of castings produced for sale. Made by the Gray and Ductile Iron Founders' Society, based on original research conducted by the International Nickel Co. in 1963.

TABLE VI

STEEL CASTINGS

Rank	SIC Code	Industry	Per Cent of Total
1.	374	Railroad equipment	41.9
2.	353	Construction, mining, and materials handling machinery and equipment	25.6
3.	354	Metalworking machinery and equipment	7.9
4.	371	Motor vehicles and equipment	6.6
5.	355	Special industry machinery	3.2
6.	331	Steel rolling mill rolls	2.8
7.	356	General industrial machinery	2.6
8.	349	Valves, pipe fittings, and other misc. fabricated metal products	2.5
9.	19	Ordnance (including tanks and tank components)	1.5
10.	351	Engines and turbines	1.0
		All other industries	4.4

Based on estimate prepared by the Steel Founders' Society of America concerning end-use distribution of steel castings produced for sale in 1965.

TABLE VII

MALLEABLE IRON CASTINGS

Rank	Industry	Per Cent of Total
1.	Automobiles	50
2.	Trucks and trailers	18
3.	Farm and construction machinery	11
4.	Valves and fittings	10
5.	General industrial equipment	4
6.	Railroad equipment	3
	All other industries	4

Based on estimate prepared by the Malleable Founders Society concerning end-use distribution of all types of malleable castings, both jobbing and captive, produced in 1965.

One interesting aspect of the trend to increased mechanization of our operations is that it has led to an increase in total foundry employment instead of a decrease. As I said earlier, total foundry employment in 1967 was 477,729 people. This figure increases every year, not only because the economy is expanding, but also because improved efficiency and quality have kept us competitive with other methods of fabrication. If such was not the case, our employment could very well be waning in spite of an expanding economy.

During this year 40% of all casting producers plan on increasing their expenditures

TABLE VIII

CASTING INDUSTRY GROWTH

Year	Production* (millions of tons)	Value** (billions of dollars)
1961	13.8	$ 6.0
1962	15.2	7.3
1963	16.7	7.7
1964	18.7	8.6
1965	20.5	9.6
1966	20.8	9.9
1967	18.9	10.5
1968	19.6	11.2
1969 (estimate)	20.5	12.0
1970 (forecast)	21.5	12.5
Percentage increase 1961 to 1970 - - - -	56%	108%

Sources: *US Bureau of the Census
**Estimated by FOUNDRY, based on
US Department of Commerce data

for plant and equipment over what it was last year. As our customer's markets continue to grow, it is estimated that our production capacity must grow at a rate of 6% a year to keep up with their needs. So the growth pattern I have shown you for recent years looks as though it will continue for the foreseeable future.

Mr. Ruf is vice-president of Grede Foundries, Inc., Milwaukee, Wisconsin.

How a technical society helps teachers

Ralph E. Betterley

After reading the preceding presentations, I'm certain you now have a better appreciation of the castings industry; its size, products and impact on business, our economy and overall way of life. It is my purpose now to touch briefly on the role of castings in school programs, and, more specifically, on how the activities of the American Foundrymen's Society help industrial arts teachers in their general metals courses, where metalcasting is taught as one area. (Ref. also IA/VE Magazine, April, 1969, "Cast Metals in Industrial Arts.")

Mr. Bohnsack gave you an excellent review of the cooperative cast metals in-service teacher course in Milwaukee. (See "Classroom Teachers", immediately preceding.) I say "cooperative" because I'm afraid he was somewhat modest as to the energetic role that he and other school personnel played in implementing this course. The overall success of the course speaks for itself. And, this was accomplished only through a cooperative team effort... along with excellent castings industry support from the Wisconsin Chapter of the American Foundrymen's Society.

In my educational work with this great industry, it has been consistently found that AFS Chapters and local foundrymen stand ready to assist teachers and their programs. It may be plant visitations, technical consultations, talks to students, and even equipment and materials in some cases.

The AFS Training and Research Institute – on a national level – also works closely with these programs through the 50 AFS Chapters by providing guidance, publications, career guidance literature, courses of study and other instructional materials.

There is neither time nor need to review all the objectives of industrial arts education today. They have been stated in many ways, and you are familiar with them. However, the question may be asked: Why teach cast metals in secondary schools? To answer this, one cannot overlook a well-established objective of your programs: "To develop in each student an insight and understanding of industry and its place in our culture." This may not be the exact wording for some of your new approaches, such as American Industry and other conceptual philosophies of teaching. However, to me, this recognized objective basically means "to interpret industry" for the student... considering, of course, basic operations, methods, machines and materials of major manufacturing industries.

Dr. Ruf has made the point clear as to the importance, size and role of this industry today. The castings industry is big business. And it is vitally basic to all manufacturing. Design engineers generally agree that "a casting is the shortest and most economical route between raw material and finished product." Well, then, if you as industrial education teachers and supervisors want to "interpret industry", why is castings technology so often missing in the metals programs in secondary schools?

There are many answers to this question, but let's touch on a few prime reasons:

(1) At the outset, it is felt that many school officials, including some teachers, are just not aware of the importance of the castings industry, and especially of the revolutionary developments that have been achieved in recent years.

(2) Often there is a lack of technical castings knowledge on the part of the teacher. Any teacher avoids that which he doesn't know or lacks confidence in.

(3) The teacher does not have the skill training to perform demonstrations and teach the subject.

(4) Teachers often lack information as to what equipment and costs are involved. Casting programs are usually thought to be too expensive. But this is not true, when compared to other well-equipped laboratories.

(5) The safety aspects of a castings program are exaggerated and not understood. Good safe practice can be learned by the teacher and then taught.

(6) One basic obstacle, perhaps stemming from the above, is fear. This fear is actually a lack of confidence.

Safety aspects are feared by teachers, administrators, students and parents alike. However, given proper facilities, teaching and equipment, casting operations are no more dangerous than other shop operations. Training for upgrading in skills and knowledge is available if the teacher is motivated to want it. By actual practice in these programs, he can dispel his fears. This is where your local foundrymen, through their Chapters and National AFS Headquarters, can be of unlimited help. Many types of in-service participation are available, including actual molding, coremaking and pouring practice. Local AFS Chapters can assist and give additional support in many areas.

(a) Industry representatives can discuss teaching and safe practices with teachers and school officials.

(b) Help provide materials and equipment. Judgment should, however, be exercised to provide used equipment suitable for school use. (Size, type, etc.)

(c) Organize plant visitations for teachers and students. Many plants offer summer employment - excellent practical experience for a teacher.

(d) Offer services for school talks and demonstrations showing new processes or techniques.

(e) Keep teachers informed of new foundry developments.

(f) Have "Education Night" Chapter meetings. Invite teachers with students and apprentices.

(g) Encourage teacher participation in Chapter activities, especially when a subject is being presented which is appropriate for school shop application.

(h) Conduct local Instructors' Seminars to improve teaching and update instruction. (Note: This has been done successfully by several AFS Chapters, e.g., the Milwaukee program)

(i) Assist schools in Career Carnival exhibits. Show the casting process and use AFS Career Guidance literature.

(j) Provide speakers for parent-teacher groups and civic organizations.

On the national level, the AFS Training and Research Institute has many activities and programs to help technical education, including yours. Time does not permit complete details of these programs; however, a brief review will quickly show the areas of our involvement as follows:

:: Career Guidance filmstrips, 35 mm color with sound tape. Two films, one for high school graduates and the other for college graduates, depict the numerous and challenging career opportunities available in the Metalcasting Industry.

Occupational Career Briefs give details of jobs in specific areas or departments of castings operations. Samples are available on request.

:: Metalcasting Instructors' Seminar – a three-day, free intensive program now held every two years in June for industrial education teachers and supervisors of casting and patternmaking programs in secondary schools, colleges and technical institutes. Started in 1956 at Michigan State University, this popular seminar is scheduled this year at North Carolina State University, Raleigh, NC, June 11, 12 and 13. AFS Training and Research Institute pays for food and housing at the seminar. Transportation expenses are covered by registrants.

:: Technical Publications – Texts and reference material on castings and patternmaking are available. Educational discounts apply on many publications. However, where several books are needed, AFS membership should be considered, for educators receive a 50 percent reduction in both membership fee and cost of books. Publication lists are available.

:: AFS Training and Research Institute provides teacher consultation and guidance for school foundries as to layout plans, equipment, casting projects and safety considerations.

:: Assistance and technical presentations for industrial education conferences, seminars and workshops by AFS Training and Research Institute staff personnel.

:: Assistance with free-loan AFS foundry films. Contact AFS film librarian.

:: Advanced intensive technical courses conducted by AFS Training and Research Institute in Des Plaines, Ill., and other cities. These courses carry a tuition fee and deal with the technology of a specific subject such as "Gating and Risering". They are primarily for industrial personnel. However, they are appropriate for the college teacher or one having experience.

:: Annual Apprentice Contest in patternmaking and molding. For apprentices and trainees. Prizes are offered at both the local and national level.

:: Membership in local AFS Chapters provides unlimited help and gives the teacher a chance to communicate better with local foundrymen and learn industry's approaches to production and control of operations.

To obtain this help, there must be better communications between the schools and industry. Our foundrymen and the American Foundrymen's Society will cooperate fully, if you ask for their help. And, they should also seek you out, for they need your students as future employees. Industrial arts also provides "consumer education". Your foundry students may some day be customers of foundries – buying their castings. In helping your students understand the casting process and its products, foundrymen have these long-range benefits also. Therefore, improve these two-way communications. You, your students and foundries will all benefit if you do.

I will close with the words of Mark Twain, "You can ascertain a lot by finding out." Now it's up to you to "find out".

Mr. Betterley is director of education, American Foundrymen's Society, Des Plaines, Illinois.

computer-assisted instruction and related areas

The computer—its role in teaching industrial arts (the state of the art)

Alvin W. Spencer

"Computers", what a fascinating subject. The whole area of computers literally rings with excitement. They are highly praised by some individuals and dreaded by others. Perhaps the most exciting thing about computers is that they are so new, and yet so few of us fully understand the role of such devices.

It has only been in the past several years that the computer has been perceived as a meaningful and significant tool to man. Its use has grown so fast and its advancement so rapid that computer technology has virtually moved us into industrial, business and scientific computerized activity almost without our recognition of this fact. The rapid growth which has taken place during the past decade is, however, predicted to be but a drop in the bucket in relation to what is likely to happen in the very near future. The truth is that the use of the computer is still in its early stage of development.

We often recognize many of the tremendous contributions which the computer has made to the business and scientific world, such as automatic billing, accounting, updating files and other applications involving data processing, but let us be assured that the computer has been equally significant in our industrial and technological environment. The area of computer technological development is, in fact, one of our fastest-growing industries today. The past few years have seen startling hardware breakthroughs, software innovations and virtually undreamed-of applications. Computer developments have been advancing so fast that manufacturers have been hard-pressed to keep up with the rate of change.

The computer has created virtually a totally new industrial environment and at the same time provided us with new potentials in industrial innovation. It is used today in supervising quality control, designing of new products, controlling machinery, automatic material handling and in running entire industrial complexes. Today's industries are receiving this modern technological advancement with great enthusiasm, for it is aiding them in shortening the time required for product development and manufacturing while providing more assurance of a quality and reliable product.

There appears to be a general myth, however, that the computer is some sort of magical device which is capable of solving all of man's unique problems. This is definitely untrue in its present state of the art. Computers are merely very powerful tools which are aiding man in his endeavors. This rather strange device is simply a machine, which has been developed by man to relieve him of some of his mundane repetitive tasks, to allow him greater freedom of thought and to enable him to work problems more quickly with less drudgery and with greater accuracy.

In the past, just a few years ago, for that matter, it took days and even weeks to collect information, to summarize it and to transmit and disseminate the information to those who had specific need for it.

The true magic of the computer is in its fantastic speed and memory capacity. Today's computers are capable of operating at lightning speeds with responses in nanoseconds (billionths of a second). Other capabilities include random access storage and retrieval, whereby any bit of data can be retrieved from among billions of other bits of information. In the broad sense, computers are designed to collect data, compare, measure, calculate and evaluate, and are quite good at their jobs.

Our modern computers are the result of a series of events which began in the seventeenth and eighteenth centuries. Briefly, the state of the art has advanced from vacuum tubes and relays (1st-generation computers) to transistorized computers (2nd generation), to integrated microminiature solid state circuits (3rd-generation computers).

The computer industry has advanced from limited memories to large, fast, random-access memory banks; and from modest simple computer systems to powerful multi-processing techniques operating in real-time and time-shared among many simultaneous remote users.

Currently computer technology is heading in two directions. One trend is toward small inexpensive computers. Even though these models are quite small, many of them have plenty of power and can perform most of the operations traditionally accomplished on larger machines. Users may use these mini-computers one day for on-line operations in which input and output (I/O) interact directly with the central processor of the computer (CPU), and off-line the next day as a "stand alone" unit, whereby the central computer is not tied up during peripheral operations. Eventually, these small computers may cost no more than a television set, and it is anticipated that these small computers will be used as part of the daily routine of housewives, students, office workers and others.

The other trend is toward large computing utilities (centers), as extensive perhaps as present-day communication systems, such as our telephone utility or national broadcasting stations. These large centers will be capable of storing vast quantities of information, and, by remote computing by means of a telephone, teletype, radio signal, microwave or laser beam, man will be able to communicate with large computer centers virtually anywhere in the world. Such systems operating on-line in real-time (OLRT) will enable the user to make discussions on vast amounts of instantly available data and information. This unique mode of operation will enable computers to communicate with each other at rates of a thousand times that of human speech. Such systems are a bit futuristic at this time, but are quite likely to affect the whole spectrum of remote, low-cost computing and information retrieval. Thus, vast quantities of information will be conveniently accessible to the user, and all at negligible costs.

Today's computer language development is also proceeding in two directions. On one hand, simpler application-oriented languages are being developed, such as interactive conversational (natural) languages, whereby man can communicate and interact with the computer in a much simpler form than with conventional methods. On the other hand, a more difficult but increasingly powerful language is being developed for use in large-scale computers.

Research in the entire area of peripherals continues to develop at a fast competitive pace. The most dramatic of the new developments are in the general area of voice operational computers. The voice answer-back (VAB) "talking computers" are able to create practically any sound in the human vocal range, along with voice inflections and accents. This enables computers to be operated and controlled by the use of conventional English. The more sophisticated units today have vocabularies made up of hundreds of words.

New innovations continue in the area of data-cells, photo-optics, video and audio peripherals, which are among the more sophisticated developments currently bringing about new ways for man to interact with computers.

The area of optics is offering promising new applications whereby any page from a stored electronic library or catalog can be retrieved, analyzed, appraised or edited per specific requirements. These optic devices (scanners) are being utilized in converting graphical information into digital form. The computer simply converts a drawing or graphic into numerical information. Stored on numerical control (N/C) tape, it can be called upon at any time for processing as the need arises.

Image processing is an area of technology which is receiving additional attention. During the past several years, systems have been built which utilize diagrams (graphics) rather than punched or typed information as a medium of interacting with computers. These systems have shown that the use of graphical input-output equipment can produce substantial increases in the computer's ability to aid man with solving relatively complex problems.

Graphics may now be wholly drawn or altered with the aid of some of the newer computer peripherals. These devices produce the required drawing or the revision of same according to the individual's specifications. Today we have available various types of x, y recorders, high speed plotters, digitizers and automatic optical drafting machines, most of which offer quality graphics with high degrees of accuracy.

Some of the newer devices, such as the photon tubes, store images and photographic images. These devices are further capable of editing and updating graphic documents and offer the capability of using microfilm as either an input or output technique.

Other new peripherals include electrostatic reproduction devices, which can transmit data or graphics to remote terminals and put out an entire printed page in less than two seconds. Developments in image display equipment are making remarkable advancements. Various combinations of cathode ray tubes (CRT) and mass storage facilities, along with on-line, real-time systems, allow the accommodation of billions of bits of data to be instantaneously displayed to the viewer. This is perhaps the basis for the greatest upheaval in the graphics area in relation to image generation and storage of graphical information. Such devices have opened entire new frontiers in the areas of computer-aided design (CAD). With such a device, an architect or engineer can literally "walk through" a building and make evaluations of the structure before it has even been built. These devices allow the behavior of an object to be evaluated and tested by drawing a model of it with a light pen onto a cathode ray tube screen and then simply asking the computer to calculate and analyze the problem.

Most intriguing and glamourous of the new devices include holographic techniques, which today are the basis for three-dimensional graphics. Here information is accessed by lasers at substantially faster speeds than present-day techniques, and provides three-dimensional, full-color graphics.

In general, computers have been well-received by industry. They have been able to stretch man's capabilities and aid him within his working environment.

Man and computer in partnership and under this new relationship have virtually a whole new potential for industrial innovation. This combination of man's foresight, judgment and creativity, interfaced with the lightning speed, massive storage and adaptive systems of information processing, is leading man into a whole new era of technological change. What role computers will play in our future is truly speculative at this time. Certainly they are not about to decline in use or in application. Every historical period and age have developed to some degree or form their own unique tools, and, as in the past, so must we become more familiar with the use of man's new tools and industrial developments.

Is it feasible that this revolutionary new man-made tool may make as large a contribution with effects similar to that which the steam engine brought to our industrial world?

Within just a few years, people shall look back on what computers are doing today as quite commonplace. Best of all, man will be able to use the computer as a tool for testing and developing his ideas, thus developing a relationship in which each, man and computer, can perform the kind of activity for which each is best suited.

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The principles of computer graphics and their application in the classroom

Wayne N. Lockwood

The development of computer graphics is the result of many people trying to make better use of the computer. Most computer users are not concerned about the inner workings of the computer. They would like to input information to the computer in the simplest, most expedient manner possible. They would like the results returned in the fastest, most meaningful form. The primary goal of computer graphics is to facilitate fast, natural communications between man and his computer. In many respects, this is the goal of the entire field of computing, but it is most apparent in the graphics area.

In the computer graphics area there are identifiable principles that apply, in part, to all commercially-available graphic devices. An understanding of these principles will help in determining the role that computer graphics can play in the classroom.

The first principle is that all computer graphic devices produce an image. The image produced could be in the form of lines on paper, sensitized dots on the screen of a cathode ray tube, points stored inside the computer or a series of characters on a line printer. The means by which images are generated is of major concern in computer graphics because of the many trade-offs that result. The most common trade-off is between speed and computer power. The faster graphic systems require larger computers and more complex programs.

The second principle is that all graphic devices are computer-controlled. This is an obvious point, but its implications are worth mentioning. Most graphic devices are "computer-independent" in design. This means that nearly any device can be used with almost any computer. No matter what computer is available, there is a graphics system that can be interfaced with it.

A third principle is that computer control of graphic devices is established through stored programs. It is the programming that determines what types of images can be generated. There are many useful applications that have not profited from this new technology as a result of the lack of programming. The availability of good programming is a major consideration in the decision to purchase graphic equipment. Even simple programs take time and effort to develop. Most companies making graphic equipment provide basic programs (often at additional cost). The large initial investment in program development can be quickly amortized by the time saved in their repeated use.

The final principle is that every program needs instruction from the user as to how it is to be used. The relationship between the program and the instructions for the program can be illustrated by the relationship between a driver and his car. Most cars have been engineered (programmed) to go forward or backward and to go right or left. The driver, having knowledge of the car's capabilities, provides instructions to the car through the steering wheel, accelerator and gear shift as to which options will be used. Obviously, the wrong combination of instructions to the car will cause it to do things for which it was not engineered, for instance, roll over on its side, climb fences and go for swims.

Providing the instructions for a program that will eventually produce an image is not very different from driving a car. A very sophisticated system of vacuum, thermostats, pumps, lubricants, valves, etc., responds to the subtle changes in pressure on the accelerator pedal. A great many complex programs and complicated hardware are ready to respond to even simple instructions on the part of the computer user.

To pursue this analogy one step further, there are many very fine drivers on the road who know very little about the internal workings of their cars. This is also true of many computer users (as distinguished from computer programmers). Through graphic programs, progress is being made in providing computer applications for persons who do not need, or want, to concern themselves with the internal workings of the computer, or with the fine points of programming.

The four points that have been developed can now be used to evaluate the more common computer graphics devices.

By far the most sophisticated device commercially available today is the cathode ray tube and light pen. The image display is very fast and can be generated from cards, from typing in information from the control panel or by simply drawing on the face of the screen with the light pen. These are all input operations that, if incorrect, can be changed immediately. The ability to make changes as the job progresses is known as "interaction" and is highly valued by designers. However, this ease of instruction and interaction is not without its price. The programs necessary to control this device are very complex, very expensive and very scarce. Generally, as the complexity of the programs increases, the size of the computer required to handle them increases also. The CRT-light pen combination is an ideal design tool, but an expensive one.

The microfilm plotter has many of the advantages of the CRT, but is non-interactive. The image is generated on the screen of a CRT. If it is correct it can be immediately recorded on microfilm. When changes need to be made, the entire program must be corrected and re-run. Several drawbacks to microfilm from an educational standpoint are that it is expensive and that an entire roll of film needs to be exposed before processing can take place.

The digital plotter and digitizer are very similar in design, and often a single device will perform both functions. Digitizing is the process of taking existing graphics or drawings and having the computer automatically generate the X-Y coordinates needed to describe the object. This is an input process and has very limited educational application.

The digital plotter performs the reverse function. X-Y coordinates that are stored in the computer are output to the plotter, resulting in the production of a graphic image. This is the most popular system, due to its low cost, the abundance of programs already in existence and the ease with which it can be used. Its most serious drawback is the slow speed at which it produces the image. However, for teaching the concepts of automated graphics, the only system that incorporates more principles than the digital plotter is the CRT-light pen system.

The application of computer graphics in the classroom could be controversial, just as the issue of whether computer graphics will completely replace the draftsman is controversial. Those persons who would use computer graphics in their classes must understand the implications. First, computer graphics is an effective tool only for those applications that have already been developed or that can be developed. It is assumed that computer graphics users already have a thorough understanding of what their graphic needs are and that the computer provides them with a better means of producing the needed graphics. Computer graphics is a tool to be used in the solution of graphic problems.

It is not an end in itself, but rather a means to an end.

Some of the applications that students at Illinois State University have been exploring and developing are in the areas of architectural details, surveying, contour mapping and nomography. Our computer courses at ISU are designed to instruct the student in the application of computers in the technical areas. They are encouraged to develop programs that will eventually be of value to students in each of the technical areas.

Once developed, the place of computer graphics is not in a computer graphics class. Rather, its place is in the drawing class where a better way to design and draw a gear is needed. It belongs in the metals class where a better means of producing and verifying N/C tapes is needed. Computer graphics belongs in every class that has a need for computers. We don't need to invent uses for computers or computer graphics; these uses already exist. We do need to find better ways to introduce the concept of computer graphics meaningfully to our students. Computer graphics is not a separate subject to be studied in isolation. Rather, it is another dimension in the technology man has developed to help shape his environment.

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Establishment of an educational program in computer graphics

Dale Bringman

From all corners we are told of the impact and importance of computers as presently utilized, we imagine their role in the future, and unfortunately we do little else. You can do something, and perhaps here we can answer questions concerning justification and implementation of programs to overcome this, another example of education's lag behind technology.

The individual attempting to overcome this lag might expect to follow a three-step procedure; (1) education and justification of the need to himself, (2) education and justification to his administration and (3) implementation of a program.

For an individual who is already overworked, underpaid and underappreciated to energetically promote a new venture, he must be able to justify the effort needed, at least in his own mind. Assuming that the individual is engaged in the usual activities of an industrial arts teacher, then the following comments should hold some significance.

First, let me quote from the 1970 edition of Source EDP, a publication whose main function is to survey the computer industry regularly and report those findings. Their outlook states that "1970 is destined to be a banner year for the computing industry. More than 10,000 people will be added to the ranks of computer professionals. Computers will be delivered at the rate of more than thirty per day throughout the year, with the total number of computers in the United States reaching more than 80,000. Opportunities will be such that an average of three outstanding positions will exist for each competent computer professional." (These opportunities and salaries are unbelievably higher than those even in the teaching profession.) The same report makes statements concerning the phases of the industrial community and the prospects for growth in terms of computer usage. All fields, including manufacturing, finance, distribution, transportation and those other industries directly related to computers, were, without exception, potential gold mines for those people with computer knowledge.

Source EDP also reports salaries for several industries and different levels of responsibility as they apply to computer users and associated personnel. The mean salaries ranged from $9500 to $30,000, excluding fringe benefits. It should be mentioned at this time that graphics as combined with computers holds a prospect for more growth than the mean based on all users.

Agreement on the points made so far is easily reached. All are intrigued by opportunities similar to those in the computer industry, but what is being done in schools, at any level, to acquaint students with the impact that those opportunities are making? For those of you in high schools who are interpreting industry, how many of you are interpreting the computer industry? How many of you are interpreting the furniture industry?

Datamation magazine makes the simple statement that the computer industry is the fastest-growing service industry in America and expects it to maintain that status for the foreseeable future. But, just as important, perhaps even more so for us, are the applications in areas normally considered to be outside the computer industry. These are topics that we can do something about by doing nothing more than adapting the present curriculum to meet some present-day needs.

When the individual has justified the validity of the need for a program to himself, the next step in establishing a program usually involves justifying the program to his administration, especially if the expenditure of funds is involved. If this is to be anticipated, he should educate himself in order to present a case of sufficient validity to encourage administrative support. Education at this point is mandatory for another reason as well. The chances of the interested teacher being responsible for the eventual instruction are great, so the time spent in learning about graphics will not be wasted.

There are several sources of information on computers and computer graphics. First, several books have been written on the topic. Periodicals such as Datamation, Automation, Graphic Science, Machine Design and many others may be obtained by individuals or libraries at no cost. In addition to self-education there are always workshops and regularly-offered courses in computer science at several universities. There is at least one other fruitful source for teachers, and that is summer employment in a firm utilizing computer hardware. Often industries, especially the larger ones, are willing to offer employment to teachers with the understanding that the teacher is there primarily to learn. One or more of the above sources should equip the individual with sufficient knowledge to promote his cause, a program in computer graphics.

The next step is to recruit as much assistance as possible for such a formidable opponent as a school administrator. You will likely find that you are not alone in your desire to acquaint students with computers. Several other areas, especially technical disciplines such as mathematics and the physical sciences, will offer support, both moral and perhaps financial.

The final step, but perhaps the most vital to your success, is to formulate a well-planned proposal with all the support you have gained contributing to a well-written document. This document will present to the administration a serious request concerning an area that is being ignored. It goes without saying that, although the proposal should encompass your needs, it should be valid in all respects, for you will undoubtedly be expected to defend it.

Implementation of the program would be an integral part of the plan. As a part of implementation, financing will probably be one of the more difficult aspects of your efforts. Additional funds beyond the normal budget may be desired. If so, you may be able to pursue various sources, such as state matching funds, private foundations and various titles under the National Science Foundation, National Defense Education Act, Education Professions Development Act and the Elementary and Secondary Education Act. However, it would appear that funds under the last four of those sources are becoming more difficult to obtain due to government cutbacks. It should be noted that whether funds are allocated or not, something can be done to present computer graphics to students.

If the available budget is small or non-existent, then techniques that are familiar to most of us may be employed. Information on graphics may be presented as a part of an existing course or a new course in the usual manner. Good textbooks in drafting now have chapters on the subject for a starting point. Do not ignore that chapter because it is too near the end of the book. Nearby industry may have a great deal of talent willing to speak to classes or to entertain field trips. Some companies, including one of the leaders in the computer graphics field, CalComp Corporation, have a touring demonstration that might be rewarding. Finally, most manufacturers of hardware, and there are several of them now, are willing to send, at little or no cost, material describing hardware, examples of graphic products, and descriptions of operation and programming techniques. Again, CalComp Corporation and International Business Machines Corporation are notable in this area.

If the budget provides some funds, then another opportunity may be present in addition to those already described. Often a nearby university or business will offer computer time to schools at a small charge. If this were made available to you then by presenting a few programming techniques, your students would be able to obtain some priceless experience at a minimum cost to the school.

If hands-on time is desirable, then a larger budget will be required. Several schools are already availing themselves of the services provided by universities, industries and computer bureaus. Time-sharing is a popular method, allowing small concerns to utilize computer power economically. However, with all the advantages of time-sharing, the capabilities of a terminal to work directly in graphics are usually not provided. The ultimate is obvious to all: the expenditure of funds to provide computer time and a graphics device. Granted, this last item is not available to many today; but, tomorrow, who knows? At least prepare yourself if the opportunity does arise.

Now let me relate to you the experiences of some people who have demonstrated their interest in computer applications, mainly graphics, and their progress in initiating programs in related computer topics. As most of you know, Illinois State University has for the past three summers conducted institute programs with the content based on industrial uses of computer power. The participants of the three institutes were recently surveyed to determine their progress. The report is too extensive to give in its entirety here, but the persons responding, who represented all levels from junior high through university, had accomplished the following: seven new courses and twenty-seven new units that together exposed over 1500 students to computers. Of the group responding to the survey, one-third had taught some computer graphics; another one-third had immediate plans to do so. One-half had requested equipment, and ten percent had received equipment. (Success is never guaranteed in efforts involving money.) Here it should be noted that the survey was taken only three months after completion of the last institute, and many of those participants had insufficient time to develop concrete plans at that time.

Finally, I would like to repeat part of a testimonial given at the American Industrial Arts Association's Convention in Minneapolis. Prior to that convention I had just completed a unit in automation with a class of high school students. The class spent a nine-week period studying concepts of computer graphics and numerical control, including hands-on time with equipment provided by Indiana State University. Two facts became apparent with the conclusion of that experiment: one, that the complexity of the material was not too great for any of the class members in a group that included students with IQ scores as low as 75. At the same time the material held challenges for all the class members, including students with IQ scores as high as 125; secondly, that group of students was as enjoyable to teach as any high school group in my experience. To be brief, the topics of computer applications fit very well into the existing curriculum.

Summarily, it is generally agreed that the importance of the computer and its application through graphics is important enough to warrant inclusion in the school curriculum. As you initiate efforts to establish a program, acquire as much assistance as possible from involved school staff, industrial support, and any available aid from funding agencies. Present these efforts in a written proposal and pray. The effort will be well spent.

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The computer: its role in industrial arts—industrial applications

James Babcock

The concept of the computers and computer graphics in industrial education will involve many philosophical questions that will have to be resolved by each of us – individually and collectively – who must determine what role computers and computer graphics will play in the area of industrial arts. It is not possible for the schools and educational institutions to duplicate the industrial community in the area of computers and – in our immediate area of concern – computer graphics.

In an attempt to suggest some direction that schools might take in regard to computer graphics hardware and software, let me briefly relate to you what we have done in industrial arts at our school. This "path" is by no means meant to be a panacea, but let me offer what we have done in the hope that it may lead to some directional ideas.

A year and a half ago it was decided that an attempt would be made to pursue and develop a vigorous computer graphics program at Chico State College. In this direction, the Industrial Arts Department joined forces with the Computer Science Department. The first step was to offer a series of weekend computer graphic sessions for local industrial firms and those other individuals – including students – indicating an interest in such a program. From that point on, the two departments – now in the same school – have worked together to develop a computer graphics program that encompasses applicable graphics in such academic areas as art, physics, chemistry, industrial technology, computer science, engineering and – among others – mathematics. Computers and computer graphics are also being applied to all phases of industrial education areas, including electronics, drafting, graphic arts, metals, industrial materials and so on.

This joint effort between the Computer Science Department and the Industrial Arts Department has led to: (1) the offering of a series of undergraduate and graduate courses in computer graphics; (2) the design of a laboratory in a new Applied Arts Building, now under construction, for the specific function of serving as a computer graphics laboratory which will include drum plotters, CRT units, flatbed plotters, and other related software and hardware equipment; (3) the development of a comprehensive and very usable passive graphics language; (4) several funded research projects that have been conducted to determine the feasibility of seventh-grade students' preparing drawings through the use of computer and plotter; (5) the completion of the only known research Master's thesis concerned with computer art; (6) the initiation of the development of a computer graphics system for making animated films; (7) the preparation of a drafting system to support a computer graphics system related directly to numerical control machines; (8) the construction of an interface to replace one that has been on loan; and (9) the making of a television tape – concerned with computer graphics – that has been shown on television.

The result of the extended effort outlined above and the demonstrated cooperation between the Industrial Arts Department and the Computer Science Department has had a "snowballing" effect. A series of equipment and research grants apparently will be the result of this extended effort and cooperation. A series of research grants with various industrial firms is now under negotiation, and one funded project is now under way.

The successful incorporation of computers into the industrial arts curriculum at Chico State College has been due to, I believe: (1) the purposeful and specific cooperation between the Computer Science Department and the Industrial Arts Department; (2) the integration into the industrial education arena of many other areas such as physics, chemistry, art, psychology – in other words – we refuse to put ourselves into a little "cube" and say "if the rest of you keep out of my little 'cube', then I won't cross over into your 'cube'"; and (3) the proposal to various companies that we will develop for them software packages on their equipment in return for their placing such equipment in our labs – the one thing we have avoided is the comment "we want to use your equipment for our students to 'mess around with'." To this can be added that the school's facilities with an industrial firm's equipment can be made available to their people for updating their personnel through the college's educational program; and (4) the serving as a regional center for junior colleges, high schools, junior high schools and industrial firms for the execution of computer graphics programs and as a computer graphics educational center.

It was indicated that industrial arts cannot duplicate industry--nor, I am sure, would we want to. However, we can gain industry's support and help by making the use of the computer in industrial arts a mutually profitable venture. Also, the joint effort between computer science and industrial arts, with the subsequent integration of a wide variety of academic areas, has had appeal to industry as a whole and – for us – has the potential of reaping some very worthwhile benefits.

Industrial computer graphics. Now as far as specific applications of computers to graphics in the industrial community are concerned, let me cite a few examples to illustrate such usage.

We are all familiar with the preparation of maps through the use of manual stereoplotting procedures. Addenbrooke's Hospital, Cambridge, England, and Fairey Surveys have developed the application of facial morphology and the rate of facial structural change effected by orthodontic treatment. Thus, the rate of facial growth and change while teeth irregularities are being treated can be studied. Their procedure involves the placement, in this case, of a child under the stereometric instrument with the child's face upward. Photographic plates are exposed simultaneously in the two photo carriers.

The film is processed and then placed in the photo carriers for stereo projection. A contour plot is subsequently produced photogrammetrically. Volume calculations can then be made from the contours as well as by watching body changes over a period of time. Much of their plotting work, however, was accomplished by hand, which was extremely time-consuming, tedious and slow. This combination proved to be a distinct disadvantage, which limited the value of such a procedure.

At Baylor College of Medicine, consideration was given to the measurement of the size and shape of various body parts for biomedical research and clinical practice, such as growth studies of human beings, studies of body atrophy such as the various decreases in size of a person's body or limb size after being in a cast, the design of prosthetics as well as other anatomical structural changes.

Dr. Herron at Baylor College of Medicine uses a similar procedure as was devised at Addenbrooke's Hospital in England. His procedure involves the use of (1) synchronized stereometric cameras to photograph that part of the body under study; (2) the stereopairs processed through the use of an IBM 7094 computer and transformed into "body-contour maps" through both drum plotters and flatbed plotters. A wide variety of plotters have been made available to him.

To review, then, stereophotogrammetry is not new – it dates back to about 1841. What is new is the application of stereophotogrammetry to biomedical research. What makes such application practical is the availability of computers to interpret the data into a form that can be utilized by plotters to transform such data into body contour maps for biomedical study and research. The use of the computer and graphic hardware and software makes such biomedical research practical as a utilitarian tool.

Additional applications of passive computer graphics. Other examples for the use of passive computer graphics employing drum and/or flatbed plotters and other passive computer graphics systems include:

(1) The passive design of highway systems, where engineers, computer and plotters become an integral unit, is currently being employed in several state highway departments in the United States.

(2) The duplication of wearing apparel patterns involving the automatic tracing and digitizing of the original pattern for computer processing. The utilization of the computer, plotter and supporting software for producing graphic patterns for all pre-established grading sizes that are to be marketed. The software is also available for producing marker patterns which are used for pattern layouts for tracing onto the fabric which will, in turn, be used for cutting out the fabric.

(3) A software program package has been developed for graphically drawing electrocardiograms. The use of a plotter system has proven much faster and more economical than the previous method of using analog equipment and photographic records of cathode-ray tube displays.

(4) The PERT (Program Evaluation and Review Technique) scheduling technique was originally developed for the Polaris missile program. For large-scale programs, however, the task of drawing and continually updating the PERT charts requires long hours of drafting time. The Boeing Company in Seattle has solved this problem by developing a software package that allows the drawing, redrawing and updating of PERT charts automatically. They are now using this software package for their attack missile developmental program as well as for other developmental programs.

(5) Other uses of passive computer graphic systems involving plotters include the preparation of geological maps, the drawing of coaxial graphs, the mapping of mine shafts with continual updating of new shafts, the graphic preparation of statistical, accounting and analytical charts for investment managers, the development of a software package by the B. F. Goodrich Chemical Development Center to provide visual results of multiple correlation analysis for graphical representation in cause-and-effect analysis, the drawing of schematics for technical documentation for commercial and industrial application by various industrial firms, the design of optical lenses, the preparation and analysis of business decisions involving uncertainties and various options, the preparation of hydrographic surveys, the preparation of weather maps, the preparation of anthropological structures, the preparation of geological maps, the verification of numerical control tapes, the preparation of working drawings for sewage treatment plants to spacecraft devices, the design of highways, the preparation of neutron scatter diagrams, the graphic preparation of animated films, the graphical depiction of mathematical models, the preparation of subdivision maps, and the graphical preparation of house plans with the possible depiction of available variations. The list may well be infinite, for each day new software packages are being developed, and new applications are being found for passive computer graphics systems. The application of the passive computer graphics system is limited only by man's self-imposed restrictions.

Just as an adjunct to the above, some computer graphic plotter times versus man times have been given by the Martin Company of Denver. For drawing the master lines for the heat shield of a rocket engine, it takes a draftsman about 40 hours, while a plotter takes just 36 minutes. For drawing various sections through an oxidizer tank and a fuel tank, it takes a draftsman 80 hours, while a plotter consumes 30 minutes. One final example involves the drawing of an engine shutdown and destruction control indicator chassis. It takes the draftsman 24 hours, while the plotter can draw the same wiring diagram in one hour.

Active computer graphics. An example of the use of the CRT unit as an active or interactive computer graphic system is one that is employed by IBM for the graphic analysis of three-dimensional data. The need for the analysis of three-dimensional data finds application – among other areas – in geology, such as surface mapping; in oceanography, for ocean floor surveys and salinity distribution based upon depth; in meteorology, for the determination of air pollution analysis at various elevations; in medicine, for heart models; in engineering, for highway design; and in the social sciences, for demography and statistical distribution.

The following slides are an example of the use of this interactive graphics system employed by IBM for the three-dimensional analysis of – in this case – a geological formation. These slides were made available by Dr. Peikert, a geologist who is associated with IBM's industry development group in Texas. (The slides were photographs of a CRT unit. It should be noted that the script and full meaning of these slides have been slightly modified for this particular presentation. One final point – the slides shown were in actuality an attempt to investigate a hypothesis.)

The first panel, the face of a CRT unit – is the main panel used for selecting major options available to the CRT operator. In this case, the operator will touch the light pen to GO TO DATA SELECTION PANEL.

The second panel provides the operator with an inventory of the available data such as longitude, latitude, oil well numbers, ground elevations, and so on. This data, and the following data, by the way, pertains to the Montana-Wyoming portion of the Powder River Basin. The operator has indicated the general area and data in which he is interested.

The third panel shows the distribution display of the data in which the CRT operator is interested. The operator touches his light pen to the tick marks which define the rectangle in which he is interested. Additional data could be added or deleted from this area at this time.

Panel six provides the operator the chance of selecting that data that he wants shown in the two combined areas, plus the capability of making a map of the two selected and adjacent areas.

Panel nine shows a contour map of the two selected and adjacent areas. This map is the result of the previously selected data. In this case, the contour intervals are 500 feet. This interval can be changed through the use of the light pen. By touching the light pen to any one of the contours, an elevation will be immediately displayed. About a dozen points had been touched by the light pen for the purpose of indicating the elevation of these various points. A smaller area may be examined by touching the light pen to those corners that will define a rectangle for closer examination.

Panel ten shows the area that has been selected from the previous contour map. A contour interval of 250 feet had been selected instead of the previously-used 500 feet contour interval. Other contour intervals could have been selected. To give the viewer a better look at this contour map, it has been decided that a perspective view of the contour map shall be displayed. The perspective can easily be rotated by changing the vertical and horizontal angles.

Panel twelve shows the original contour map. The horizontal line that appears near the center of the map indicates an area we wish to see in cross-section. This line was placed on the CRT unit by touching the light pen to two different points that indicated the beginning and terminating points of the desired cross-section. By touching the light pen to the VERIFY DETECT, a line will join the two indicated points. This then will be the selected cross-section, which can be shown simultaneously with other selected cross-sections of the previously-shown contour map as they appear upon the CRT unit, in varying perspectives and degrees of detail

Other uses of active computer graphics. Ford Motor Company utilizes an active graphics system for analyzing the complex movement of windshield wipers, convertible tops, various hinges and other complex analytical tasks in spatial mechanisms. The movements of the various mechanisms can be stepped through its motion either incrementally or continuously and automatically.

Additional examples of active computer graphics include: (1) the active design of integrated circuits, (2) the design of ship hulls including optimum hull design for reducing water friction through the testing of various alternatives, (3) the optimum visual design and redesign of automotive panels, (4) the determination of the functionality of electronic circuits and of their workability prior to any construction, (5) the evaluation of the image quality of an optical system, (6) the graphic analysis of mechanisms through the display of their displacement, velocity, acceleration, (7) the estimation of piping lengths and sizes in the chemical and petroleum processing industries, (8) optimizing the design of multi-layer printed-circuit boards including the most desirable physical configuration for the desired application, (9) the analysis of the effects of various loads on beams, columns and other structural members, (10) the determination and then optimization of the path of a cutting machine tool after which a numerical control tape can be automatically prepared, (11) the generation of a three-dimensional surface contour of a numerical model that may be rotated for observation from any direction, (12) the analysis of vibration in various aircraft structures and components, (13) the animation and simulation of a wide variety of operations including such applications as a sequential pilot's view of an aircraft-carrier flight deck from a tentatively-designed cockpit, and (14) the design of airfoils and the utilization of the CRT unit as a wind tunnel for testing the design of various shapes.

The application of CRT units to graphics is widespread, and once again this application is limited only by man's ability to recognize that available potential and utilize it.

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The implementation of computer-assisted instruction

John P. Novosad

The first all-electronic computer was built at the University of Pennsylvania in 1946. The first computer, reproduced commercially, was delivered to the Bureau of the Census in 1950.(1)

The computer has since developed into a most sophisticated tool. Its numerous and varied applications range from payroll preparation to space vehicle control. A recent census, prepared by a professional consulting firm, stated that as many as 70,000 computers were installed in the United States by the end of 1969.(2)

The computer's capabilities and applications are steadily increasing. Time sharing, for example, permits many stations to share the resources of a very large computer. These resources include elaborate data banks which are used for such purposes as credit information, medical records and income tax data. A recent trend, significant to education, is the marketing of much smaller, less expensive, easier to operate and more accessible computing equipment.

One of the most rapidly advancing applications of the computer is in the field of education. A review of relevant literature indicates that the promise of computer technology is one of the great expectations in education.

Michael Alan expressed his opinion relative to the computer in education in the following manner:

> The wonder of all this is that the computer has arrived so late to class. For, in the United States, the world's most computer-conscious country where from Wall Street to Washington men listen to their machines, the computer had to wait until the mid-sixties to get inside the classroom.(3)

The computer, which makes the sophisticated teaching machine possible, is beginning to perform increasingly important tasks in instruction. An example, in industrial education, was the development of a computerized occupational program at The Pennsylvania State University. This program, developed in the Vocational Education Department for use by ninth graders in occupational exploration, used information by way of a computer-based terminal device as a vehicle by which students would explore occupations as well as develop individualized strategies for doing so. The terminal, composed of a typewriter device, a tape recorder and a slide projector, was controlled by a computer via a telephone line.(4)

The computer's role in instruction becomes more significant as new innovations are created and applied. Research in such areas as instructional technology, cybernetics and human engineering will continue to contribute to this advancement. Dr. Edgar H. Auerswald, head of the Psychiatric Division at New York's Beth Israel Hospital, stated:

> A child's use of computer-based technology in learning, within a properly supervised situation, should have little or no effect on his ability to develop interpersonal relationships in later life....
>
> It should also be noted that a child develops his basic ability to form compassionate relationships at a very young age – long before he reaches a stage where he can use technological learning systems. A child's exposure to the machine in learning does, at times, eliminate an interpersonal relationship that prevents learning, but it also prepares him for the use of technology which will become more prevalent in our society in future decades.(5)

Joseph Margolin expressed the significance of the computer's role in education in the following manner:

> The gestalt of the educational environment suggests an interesting concept. Perhaps we can create a new kind of "book" for each child. One that takes note of, and is geared to, his perceptual and cognitive style, that addresses itself to his areas of interest and enthusiasm, to his pace and his level of maturity. Such a "book" would exist in the memory of the computer and, where appropriate, could be reproduced by xerography to be taken home for study. Above all, it would be his – the only "book" of its kind in the world.(6)

Computer systems will grow rapidly, in number and kind, as computer technology continues to overcome technical and economic obstacles. This growth will spread to education and will be influenced by innovations that have as yet not been discovered. The continued growth and expansion of this industry will cause computer technology to appear more dominantly in subject matter as well as in innovative instructional systems for the classroom.

These developments can drastically affect the familiarity an individual has with a system, the data stored in the system, and the forms of data retrieval available.

As in business, industry, the military and government, the successful utilization of computer technology requires careful advance planning.

Intensive evaluation is required of such items as: selection of equipment, initial and recurring costs, facilities, maintenance, training, scheduling, certification, validation, obsolescence and information security. The mere injection of hardware into the classroom without appropriate planning cannot be condoned. For, besides the high costs resulting from inadequate equipment, the available hardware could dictate curriculum reform, rather than the other way around.

Katzenbach stated:

"...innovation in education is coming largely from industry and government....

"...you should not just visit other schools noted for innovation; ... You should also ask large businesses...."(7)

Woodson and Conover reported nine areas in which computers excel:

(1) Where operations are required to be repeated very rapidly, continuously and precisely the same way over a long period of time.
(2) Monitoring of people and other machines.
(3) Responding very quickly to control signals.
(4) Storing and recalling large amounts of information in short time periods.
(5) Performing complex and rapid compilation with high accuracy.
(6) Doing many different things at once.
(7) Deductive processes.
(8) Insensitivity to extraneous factors.
(9) Operating in areas that are beyond human tolerance.(8)

The computer is exploited in industry in all nine of these areas. All nine of these areas have implications for computer-assisted instruction in education, especially industrial education.

FOOTNOTES

(1) Roger Nett and Stanley A. Hetzler, An Introduction to Electronic Data Processing (Glencoe, Illinois: The Free Press, 1959), p. 39.

(2) "Forecast US Computers will rise to 70,000," Information Week, December 8, 1969, p. 6.

(3) Michael Alan, "The teacher who 'never gets angry'." Parade (February 2, 1969), 9.

(4) Joseph T. Impellitteri, "The Development of a Computer-assisted Occupational Guidance Program," Journal of Industrial Teacher Education, Vol. 6 (Summer, 1969), 17-27.

(5) Theodore Irwin, "The Wondrous Machine That Salvages Backward Kids," Today's Health (August, 1969), 31-71.

(6) Joseph B. Margolin, "Are we building a tower of Babel?," American Education (November, 1967), 12.

(7) Edward L. Katzenbach, "Cooperative Planning for Utilizing Technology in Education," in Designing Education for the Future, No. 6, ed. by Edgar L. Morphet and Davis L. Jesser (New York: Citation Press, 1969), p. 127.

(8) Wesley E. Woodson and Donald W. Conover, Human Engineering Guide for Equipment Designers (Los Angeles: University of California Press, 1964), p. 23.

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Video-tape and industrial education

J. F. Entorf

(This presentation is based upon a dissertation completed in the Industrial Education Department of Texas A&M University in the spring of 1967.)

Rationale for the study – shortage of teachers. A review of the literature substantiated an obvious need for qualified instructional staff with little hope for satisfying that need. Reputable sources within and without the field of industrial education suggested that the need for qualified instruction could be met only by increasing teacher efficiency, with emphasis on instructional media and machine teaching. Further research in available literature suggested television as one of the more promising media. Some research had been conducted in the use of direct wire TV for enhancing demonstrations, etc., but no research had been done using video-taped closed circuit TV in the field.

The problem. As there had been essentially no work done with the use of closed circuit video-tape in the field, the scope of the problem had to be narrowed. In delimiting the problem, consideration had to be given to the availability and accessibility of equipment, which imposed a limit on the number and complexity of demonstrations that could be made.

In the final analysis, the problem was limited to the evaluation of the effectiveness of using video-taped lessons to present related technical information. The video-taped lessons were compared with the conventional method of teaching this material (lecture supplemented with visual aids). The two methods were used to teach four units of related technical information associated with a beginning woodworking course designed for college architectural students.

Research materials – design of the experiment. With the assistance of Dr. Dayhoff, Institute of Statistics, Texas A&M University, a statistical design was established. A generalized crossover design was employed where all students involved in the experiment would be subjected to both the experimental and conventional methods. The sections were randomly assigned to the experimental and control groups for Unit I. The same arrangement of groups was maintained for each unit of information, but the method of presentation was changed. For Unit I, sections 1, 2 and 3 received instruction by the conventional method, while sections 4, 5 and 6 received instruction by the experimental method. For Unit II, sections 1, 2 and 3 became the experimental group and sections 4, 5 and 6 became the control group. The method of instruction was reversed for each of the units which followed, so that each section would receive two units by the conventional-lecture method and two units by video-tape.

Unit selection and development. Because the experiment was to be conducted within the structure of existing classes that had clearly-defined content, the selection of units to be taped was made on the basis of judgment as to which units would best lend themselves to video-taping and the feasibility of acquiring or developing visual aids for the materials selected. The number of units selected was governed by the statistical design – an even number was required.

The development of each unit was undertaken with the assistance and advice of the instructors responsible for teaching the courses used in the experiment. To insure that the units adequately covered the material, a topical outline of each unit was sent to a jury of woodworking teachers. Following jury approval, the units were divided into lessons. This division was based on two factors: (1) the optimum time length for video-taped lessons is 20 minutes, and (2) each lesson should cover only closely-related material. The four units were divided into lessons as follows:

Unit I Forests and Trees	
Lesson	
1 - Forest Reserves	15 minutes
2 - Tree Structure and Classification	16 minutes
3 - Common Hardwoods and Softwoods	17 minutes
Unit II Harvesting and Manufacturing	
Lesson	
1 - Harvesting	15 minutes
2 - Processing	16 minutes
3 - Drying and Grading	18 minutes
4 - Lumber Mill Products	18 minutes
Unit III Methods of Fastening	30 minutes
Unit IV Wood Laminations	20 minutes

Production of video-tapes. For each lesson a written script and visual aids were developed with the advice of the television production staff. Visual aids used included slides, segments of sound motion picture film, samples of materials and key cards. To reinforce the visual aids and narrative, key words or phrases were superimposed on the screen as each topic was discussed. The written script was used to enable the visual aids and key cards to be changed at the correct time.

Conventional-lecture method. As used in this study, the conventional-lecture method employed teacher lectures supplemented with visual aids. The teachers of control sections were provided with a copy of the unit outlines and all of the applicable visual aids. Art cards and key cards were not considered applicable. A total of 99 slides and two 30-minute sound motion picture films was made available to the teachers.

Evaluation instruments. Because of the nature of the material presented, the evaluation of either method was limited to the student's understanding and retention of the material presented and his attitude toward the methods of presentation. An objective test composed of four-response, multiple-choice questions was developed for each of the units. These were validated by submission to the jury, together with unit outlines.

A pre-test to be administered at the beginning of the semester and a final test to be administered four and fourteen weeks after instruction began were developed by combining the four unit tests. Items from each test were arranged so that questions from each unit were found on every page of the pre-test and final test. The same questions were used for all tests to make them equal in weight and comparable. It was assumed that any learning which occurred because of familiarity with the test questions would be equally distributed for all sections.

A reliability coefficient was computed for the entire test and each of its sub-parts using the Kuder-Richardson formula (see Table I). The reliability of the achievement test and the unit tests is considered adequate for research purposes by Remmers, Gage and Rummer. The low reliability of the unit tests results from (1) the length of the tests, (2) the Kuder-Richardson reliability formula used and (3) the homogeneity of the group used (see Table II).

TABLE I

TEST RELIABILITY

Test Part	No. of Items	r_{11}
Achievement Test	130	.77
Unit I	35	.58
Unit II	40	.56
Unit III	30	.59
Unit IV	25	.57

TABLE II

GROUP VARIANCE BASED ON SAT

Group	N	X	S^2
T A M U	2088	1027	200
College of Engineering	708	1060	149
Students in Experiment	128	1009.7	134

Questionnaire. Because the experiment involved two methods of presenting identical information, the attitude of the students toward the methods of presentation was considered important. As no standardized attitude scale applicable to the situation was available, a questionnaire to obtain student opinion about the two methods was developed.

Test administration. The class sections were scheduled two hours a day, three days a week. The length of lessons was such that a single unit could be scheduled for presentation during the first hour and the unit test administered during the second hour.

The four unit tests were administered four times as follows:

(1) Combined as a pre-test to determine prior knowledge of subject matter and group equivalence. A comparison of F ratios for the pre-test and SAT for the two groups shows them to be equivalent. (See Table IV.)

(2) Individually as unit tests immediately following the presentation of units.

(3) Combined as a post-test four weeks after instruction began.

(4) Combined as a retention test fourteen weeks after instruction began.

TABLE IV

Measure	N	Groups	S^2	F
SAT Aptitude (total)	129	1	19,080.00	1.173
		2	16,259.00	
Achievement Test	148	1	64.20	1.172
		2	54.75	

The questionnaire was distributed one week after the last unit was presented. The students were to answer the questions thereon and to comment on the methods of presentation as they saw fit.

Analysis of data. Three statistical procedures were used to analyze the data gathered, analysis of variance, pooled T, and X^2 approximations. Table V shows the appropriate F - ratios for the fixed effects model for unit effect, method effect, and unit by method interaction.

TABLE V

F-RATIOS FOR FIXED EFFECTS MODEL

Source of Variation	Mean Square	F
Mean	M	
Treatments		
A (units)	A	A/E
B (methods)	B	B/E
AB (interaction)	AB	AB/E
Experimental Error	E	

The pooled T test was used to compare the two methods on a unit basis rather than by analysis of variance.

The X^2 approximation was used to analyze the responses on the questionnaire.

Method comparison. The two methods were compared over all four units of information for the unit, post and retention administration of the test. Differences in the effectiveness of methods for individual units will be discussed later.

Unit administration. Tests for each unit were administered immediately after the presentation of the informational unit. (See Table VI.) The data thus gathered was analyzed to compare methods over the four units. Table VII shows the F ratios for units, methods, and unit by method interaction. All F ratios are significant at the .01 level of confidence.

TABLE VI

PRE-TEST ADMINISTRATION

Groups	N	X	S^2	S	t	F
1	75	47.55	64.20	8.01	.141	1.173
2	73	47.64	54.75	7.40		

TABLE VII

ANALYSIS OF VARIANCE—UNIT TESTS

Source	df	SS	MS	F
Mean	1	281,307.94		
Treatment				
A (units)	3	9,635.18	3,211.72	256.94**
B (methods)	1	722.01	722.01	57.76**
AB (U x M)	3	139.31	46.43	3.71**
Error	582	7,287.60	12.50	

*=.05 level of confidence **=.01 level of confidence

Post-test. The post-test consisted of the combined unit tests administered four weeks after instruction began. Table IX shows the F ratios for units, methods, and unit by method interaction. All the F ratios are significant at the .01 level of confidence.

TABLE IX

ANALYSIS OF VARIANCE—POST TEST

Source	df	SS	MS	F
Mean	1	239,604		
Treatment				
A (units)	3	4,870.3	1,623.4	121.1**
B (methods)	1	139.1	139.1	10.3**
AB (U x M)	3	142.0	47.3	3.5**
Error	596	8,006.6	13.4	

*=.05 level of confidence **=.01 level of confidence

Retention test. The analysis of variance for the retention test administered fourteen weeks after instruction began is shown in Table XI. The F ratios for units and methods are significant at the .01 level of confidence. The F ratio for the unit by method interaction is nonsignificant.

Comparison of units. As previously stated, the analysis of variance could not be used

TABLE XI

ANALYSIS OF VARIANCE—RETENTION TEST

Source	df	SS	MS	F
Mean	1	187,308		
Treatment				
A (units)	3	4,356	1,452	60.50**
B (methods)	1	91	91	6.06**
AB (U x M)	3	72	24	1.6
Error	592	8,669	15	

*=.05 level of confidence **=.01 level of confidence

to compare methods on a unit basis. To do this, the pooled T test was used.

Comparison of the two methods on a unit basis indicates that:

(1) Units I, II and IV contributed significantly to the difference between methods at the .01 level of confidence on the unit administration.

(2) Units II and IV contributed significantly to the difference between methods on the post-test administration at the .10 and .01 levels of confidence, respectively, and

(3) Units I and IV contributed significantly to the difference between methods at the .05 level of confidence on the retention test administration. Only Unit IV contributed significantly to the difference between methods at the .05 level of confidence or above on all three administrations of the test. (See Table XIII.)

TABLE XIII

SUMMARY OF UNIT POOLED T VALUES FOR THREE ADMINISTRATIONS OF THE ACHIEVEMENT TEST

	ADMINISTRATIONS		
UNITS	unit	post	retention
I	4.016**	.033	1.810*
II	3.130**	1.623	1.230
III	1.554	.406	.224
IV	7.330**	5.720 **	1.687*

*=.05 level of confidence **=.01 level of confidence

Questionnaire analysis. The questionnaire administered was composed of three questions with space for individual comments. Two similar questions were asked to check on the validity of answers. Because these questions yielded almost identical answers, only one will be reported. The responses were analyzed using the X^2 approximation to the normal distribution. Table XIV summarizes student responses to the questionnaire.

TABLE XIV

QUESTIONNAIRE ANALYSIS

Questions	Responses		X^2
Which of the methods do you prefer?	Video-tape Lecture	39 103	27.94**
Which method covered the material best?	Video-tape Lecture	47 95	15.56**

*=.05 level of confidence **=.01 level of confidence

The X^2 values derived for each question show that:

(1) at the .01 level of confidence a significant proportion of students preferred the conventional-lecture method, and

(2) at the .01 level of confidence a significant proportion of students believed the conventional-lecture method covered the material more thoroughly than video-tape.

Analysis of the comments on the questionnaire revealed two consistent objections to video-tape:

(1) The rate of presentation prevented comprehensive note taking, and

(2) The students were unable to ask questions or discuss a point in detail until the entire video-tape had been played.

The purpose of this experiment was to compare the effectiveness of video-taped closed circuit television and the conventional-lecture method of teaching related technical information. The criteria used to evaluate results were initial learning of subject matter immediately after each unit was presented and retention of subject matter four and fourteen weeks after instruction began.

With a single exception, the video-tape method resulted in higher mean scores for every unit on all three administrations of the test. Measured over the four units, this difference was significant at the .01 level of confidence for the unit, post and retention test administrations. When methods were compared on a single-unit basis, only specific units showed significant differences, indicating that some units are more appropriate for video-taping than others.

Based on the data gathered, it would appear that video-taping is at least as effective as the conventional-lecture method. In some instances it appears to be more effective, even though students indicate a preference for the conventional-lecture method. If student objections to video-tape can be lessened or overcome, this method holds promise of alleviating some of the problems created by the search for qualified instructional staff.

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Computer-assisted instruction

Raymond G. Fox

CAI technology. For a long time, an objective of educators has been to individualize instruction. Employment of the computer to mediate this process has been a subject of research interest as a potential approach to achieving this objective. While Computer-assisted Instruction (CAI), as this technique is called, is in a research phase, there are several operational or developmental training programs already installed, which will be described later. In discussing the subject, however, it may be useful to define CAI in nontechnical terms.

CAI is a technology using the computer for two functions: first, to control information presentation to a student and, second, to process the student's response to the information presented. These functions constitute a cycle of presentation and response. The student's response causes the computer to actuate the next presentation. In making a response, the student is said to interact with the computer. Thus, CAI is the use of a computer in an interactive mode.

There are a number of mechanisms used to accomplish the function of information presentation and to permit a response by the student. An objective of CAI systems is to have information presented to the student in familiar forms, such as still pictures or images, prerecorded sound messages, typewritten material, moving pictures and cathode-ray tube (CRT) displays. The computer controls the sequencing of the information presented by actuating the individual devices in accordance with the instructions set up by a course author. Some types of information presentation devices are:

(a) Tape recorders for audio messages
(b) Slide, strip or movie projectors for images or pictures
(c) Teletypewriters (computer-actuated) for typewritten text
(d) CRTs for images, drawings or text presentation.

Elements of the computer, which are used to control these devices, are magnetic disk files for storing course materials and student records; a central processing unit which performs the logical functions of the course, as determined by the course author; and a multiplexer unit which directs messages between the student terminals and the computer.

Information presentation devices are grouped into what is known as a student station. At the station, or learner carrel, the student will be able to see and hear the information being presented and to respond by means of one or more response devices. Response devices are also familiar mechanisms which vary depending upon type of response required. Present CAI systems have a capability to permit one or more types of responses, including multiple-choice, constructed answers, and dial or switch setting. The response devices are linked to the computer, causing the computer to actuate the next information presentation. Some of the devices used are:

(a) Keyboard – usually a teletypewriter device with alphabetic, numeric or combination key entry capability

(b) Light pen – a device which can be used on a CRT to actuate a response by touching a given position on the CRT

(c) Simulator – a dial, switch or key depression device having the outward characteristics of operational equipment. An example of this is the Audiometer Trainer.

The student response is made by means of the particular response device indicated in the program of instruction; depending upon the response, it causes the computer to select the next information frame.

Functional characteristics of CAI. The previously-described information presentation and response cycle, operating under computer control, has some inherent characteristics of interest to the educational researcher and to the educator. The more readily identifiable characteristics of this technology are listed below.

Individual pacing. By virtue of the presentation-response cycle, the learner can consider a frame of information in whatever form or forms presented (picture, audio message, etc.) and take either as much time as he desires or as much time as the author allows prior to his response. He can proceed at whatever pace he chooses.

Material presentation control. Material presentation is based on a sequence determined by the course author. The student is branched or directed to various frames as a function of his response. It is, therefore, a characteristic of CAI to have the author control the material presented, its sequence of presentation and the branching desired, depending on student response.

Response analysis. Two capabilities of the computer, included in the information processing function, are the collection and recording of an individual's responses to given frames of information and the measurement of the time required for each response (response latency). This gives the researcher and the proctor objective data to indicate the student's progress, frames of instruction which may be troublesome, time requirements for students on specific frames of instruction, and sequence patterns for different individuals. This capability may be desirable in research applications to determine optimum sequences, to relate learning patterns to learner profiles, and to examine response latency in various aspects. It may become one of the tools which a teacher can use to alert him to specific learner problems at the time they occur, thus permitting him to provide assistance at that time. With such information the teacher may gain new insight into the learning process.

Applications of computer-assisted instruction. CAI course segments have been written and tested on many college campuses and in training activities for the military services. The college and university work in CAI has been characterized by a research orientation. The work done in the military services has been directed toward training military personnel in functions where specific terminal behavioral objectives have been clearly identified, and cost effectiveness could be demonstrated or closely approximated. Types of CAI systems described may be classified as drill and exercise, tutorial, and hands-on trainers. These are useful terms, although complete agreement has not been reached as to their precise definition. For the purpose of this introduction to CAI, some pertinent examples have been selected from the work IBM Federal Systems Division has accomplished under contracts funded by the Department of Defense and the Office of Education.

Drill and exercise. The drill and exercise mode refers to an essentially supplementary type of material presentation which enables the learner to grasp specific subject matter by drilling until he remembers it. It approximates a standard programmed instruction course which is adapted for the computer. The computer provides a convenient information storage means and permits proficiency updating and testing. An example of this is the Air Force's "Conquery" course. Used for training on operational systems, Conquery is an IBM-developed CAI course to train Air Force personnel in the use of a special Air Force data base. In this course, the students are taught basic, remote and advanced programming techniques. At appropriate times, the student is presented with practical exercises in which he makes actual queries of increasing complexity from the data base. In this unit of about 30 hours of instruction, Air Force analysts receive training in a computer language to enable them to ask questions of a file which is stored in a computer for rapid information retrieval. The equipment used for retrieval is a Teletype or IBM terminal connected to an IBM 1460 computer. The analyst's job requires him to receive reference information from the data file stored in the computer, using the Teletype, to analyze reports received from other sources. Also stored in the computer is the material for the CAI course on the query language. Thus, while the analyst is using the terminal to communicate with the computer in performing his job of information analysis, he also is using it to take the CAI course in computer query language.

Another example comes from language training at the Defense Language Institute. From October, 1968, through June, 1969, IBM conducted a project with the Defense Language Institute West Coast Branch (DLIWC) at Monterey, California. That project was a three-phase experiment designed to evaluate the use of computer-assisted audio instructional techniques in the Russian Aural Comprehension Course taught at DLIWC. The first phase consisted of the preparation of instructional material by DLIWC instructor personnel in a format specified by IBM instructional systems specialists. During the second phase, linguistic material was presented to DLIWC students via IBM 1050 Audio Terminals under the supervision of DLIWC instructional personnel. In the third phase, student aptitude and performance data were analyzed and evaluated. The results indicate that the techniques employed for materials preparation, instructional administration, and data collection and evaluation were satisfactory prototypes, fully consistent with the requirements of an operational computer-assisted training environment. In addition, the Monterey study showed that computer-based assessment data has the high accuracy and reliability required for instructional management decisions.

Tutorial mode. The tutorial mode of CAI presentation is used when approximately 80 percent of the material is presented at the terminal under computer control. It implies a rich mix of information presentation mechanisms and a wide variety of response choices or methods. An example of this type of CAI program is the material developed by IBM under contract to the US Army Signal School. In a formal school setting, a study of CAI for the US Army Basic Electronics Training at the US Army Signal Center and School established the feasibility of CAI as a training technique. This material was equivalent to 11-1/4 hours of conventional presentation in entry-level electronics. The IBM 1500 Instructional System – consisting of a central processor, input/output devices, disk storage and up to 32 student stations – was used. Each student station consisted of the 1512 Image Projector (with up to 1000 images) and the 1510 CRT with keyboard and light pen. This unit can display up to 640 characters on the face of the tube and change the display, or part of it, in 1/30 of a second.

In carrying out this contract, material on electronics was prepared and administered on a CAI basis to a selected group of students. Comparable student groups were given the same material by the conventional classroom method and by the television classroom method. When the three groups were compared, CAI was shown to be as effective as current training methods in teaching a portion of the basic electronics course to a group of Signal Corps students. Moreover, the students taught by CAI completed the course in an average of 11 percent less time than the students taught in the classroom. An analysis of the cost data identified those conditions under which the CAI could achieve cost effectiveness. Subsequent to this study, the material was revised and administered to 278 regularly-assigned students, who took the CAI materials as a part of their normal instruction. The Signal School at Fort Monmouth, New Jersey, analyzed the data collected and reported that vis-à-vis conventionally-trained students, the performance was equivalent, with more than 20 percent savings in time.

Hands-on trainers. Hands-on trainers refers to the units required for skills training of students on the actual devices or device simulators. The Audiometer Trainer Unit (ATU) is an example of how CAI is utilized for this type of training. The ATU is a unique device for the application of CAI in teaching the use of the audiometer to students in audiology courses. The audiometer is a device used to test a patient's hearing. Presently supplied by several manufacturers, the audiometer varies in design, depending on its use. It is used in schools as a screening device and in hospitals or clinics for more specialized examination.

The course requirement is for the students to be given practical laboratory exercises or "hands-on" training with the audiometer. For training in the use of devices, it is considered a requisite for the student to have the actual device at his disposal and to perform practical exercises or simulated routines on it. In addition, the requirement exists for the instructor to be able to monitor or critique the student's step-by-step progress on the device and to test his proficiency in its use. In learning to operate and perform hearing examinations with the audiometer, it is necessary for subjects to be available to act as patients. In audiology classes these "patients" are other students whose hearing is usually normal. Thus, the desired practice of testing a patient with hearing defects is not obtainable.

The Audiometer Trainer Unit, operated in conjunction with CAI, has been developed to provide individualized step-by-step instruction in the operation of audiometers without the necessity for an instructor to check or test performance at any point. In addition, by simulating the patient under examination through the computer program, the student may be presented with hearing characteristics with any pathological abnormalities desired. Audiometer malfunctions may even be simulated.

The ATU outwardly is representative of audiometers in general use. It has the same dials, switches, etc., that the student will find on actual audiometers. However, the similarity of the ATU to actual audiometers ends at this point. Internally, the ATU contains instrumentation for encoding the position of these controls as well as control circuitry for supplying to the computer the exact position to which the student has them set. Depending on where the student has set the controls and where he is in the sequence of course material authored, a response to the student will be made by a patient signal light indicating whether the patient hears or not. Communication to the student may also be through use of any of the other CAI station terminal devices available.

Current state of CAI in training. While much thought has been given to this subject in industry and the schools, a principal force in identifying CAI for training has been the Department of Defense.

In 1968, at a meeting of industry representatives from NSIA's Training Advisory Committee and key training executives for the Department of Defense, the subject of applying the computer to the training of DoD manpower was considered, and methods better to understand the problems and their potential solutions were discussed. It was concluded that a valuable service could be rendered by NSIA in sponsoring a special committee which would identify and concentrate on this specific area in the hope that improved effectiveness in the training process would result. Accordingly, the Applications of Computers to Training committee was established. The first task of this committee was to identify committee work functions to be accomplished. The following functions were identified:

Application definition. This function is to identify applications of interest to the committee. Applications suggested for consideration were Instruction in Computers; Computer-assisted Instruction (simulation and media or device control); Pupil Information Systems; Training Manuals; Interactive Guidance Counseling; and Management of Instruction (scheduling of students, facilities, materials, etc.).

Library and dissemination of information. This function identified tasks to be considered in the development of a program for a library and dissemination of information on the uses of computers in training. Work tasks defined were program definition; applicable library management techniques; and user requirements.

Demonstration and training. This function was identified for the purpose of communicating the findings of the subcommittee by a symposium type of meeting and follow-on seminars involving DoD and industry representatives. It was decided in 1968 that the most effective means of accomplishing this would be a national program of panel discussions involving topflight people with known reputations and workshops involving the military services and industry.

Hardware and software. The committee recognized the need to identify the requirements, specifications and interchangeability of hardware and software in the field of training and education. On a long-range basis, some of the specifics suggested for consideration in the software area were frame definitions and specifications; course specifications; languages for the computer; programs for evaluation and management; simulations and games. In the hardware area the committee sees a need to look at the requirement for audio/visual devices, computers, simulators (analog), terminals and displays as they relate to education and training.

The ideas, program and proposed functions of this committee were reviewed by the various military services, and it was determined that this was a desirable approach. Appropriate representatives to the committee from the Office of the Secretary of Defense and each of the military services were appointed.

In carrying out its objectives, the committee recently conducted a national conference of several hundred training executives from industry and the Department of Defense. During the two-day conference, 20 papers were presented which described the state of the art as it was known to the conferees and explored the future as they conceived it.

Some of the important concepts outlined at this conference were that there does exist potential in using the computer for individualizing instructional systems, for improving quality and speed, and for developing human resources. It also became evident that an enormous job exists in the development of materials in order to apply the computer to this process and to evaluate its application on individuals.

In summary, I believe the words of Curtis W. Tarr, Assistant Secretary of the Air Force for Manpower and Reserve Affairs, are appropriate, and I quote:

"I think all of us interested in education must maintain this concern for the development and growth of the individual. Too often we practice the slovenly habits that come to those who have a surplus of human resource with which to work so that we can discard some people from consideration. As society advances, the price of discarding human talent grows to a point where eventually it becomes intolerably expensive in both economic and social terms. I think we have reached that day. The consequence is that we as leaders must learn to become teachers who encourage growth rather than be merely shrewd judges of human talent. It is in this environment that we in the Air Force look forward with anticipation to what you and others can help us to realize through the intelligent exploitation of the possibilities of computers in training."

Mr. Fox is manager for Educational Systems Development, IBM, Arlington, Virginia.

Individualized instruction

Robert W. Singer

My experience in individualized instruction is limited to applications of the Didactor. The Didactor is a specialized, economical, portable computer and functions as a type of "teaching machine".

The general heading of individualized instruction usually includes the application of programmed booklets, sometimes cassette recorded messages – a collection of books and equipment brought together to assist self-instruction. This is normally done by providing a booth or carrel which semi-isolates the student. Quite often the student is given a study guide which suggests reading materials, tapes, films, slides, etc., that he might go over. Thus, by following the guide, the student uses the materials in the facilities provided and carries out a program of self-instruction that is usually more effective than if he were given an assignment to withdraw books from the library and turn out a report. Of course, one of the main reasons why this approach would be more effective is the use of study material in the format of programmed instruction.

I'm sure almost everybody is familiar with the programmed instructional format and holds their own opinions as to why it works. I think it works primarily because it presents material in short steps and because effort is made to write such materials in simple English with lots of repetition. We tried an experiment several years ago where we took a rather complex paragraph of about 400 words and did nothing more than rather arbitrarily break it up into eight short paragraphs. Wording was not touched, but students got much higher scores when questioned on the content of the broken-up version. Undoubtedly a page that is a solid mass of print just looks unconquerable to some people.

However, as I said, my experience is somewhat different from this, mainly because we have concentrated on orienting the individualized self-instruction to a controlling device. This controlling device is a form of computer-assisted instruction and serves as a simulated teacher. It has several functions:

First, and primary, to detect how well the student seems to understand what he is studying and to alter the course of study to accommodate him. This may mean accelerating the complexity of presentation or further simplifying it.

Second, to control whether the student will work on certain portions of material at his own pace or whether he must work at some pre-established pace. (Exercises or drills in basic arithmetic and reading skills particularly require this kind of control.)

Third, to control the use or functioning of other media; such as turning on and controlling a slide projector, movie projector or tape recorder.

So you see, our approach calls for a program to be structured which controls the self-instructional situation, but has the versatility to alter this control; that is, individualize it, in accord with the evidence detected as to how the student is progressing.

Now let me elaborate on how this is done. The Didactor, our main controller device, has a small screen on which lessons are presented. Incorporated in each such presentation is a question and multiple-choice answer. There are five pushbuttons on which the student can indicate his choice of an answer. Each such response by the student causes the Didactor to pick out an appropriate follow-on presentation. If the student made a good response, the following presentation will continue the basic trend of the course. If the student made one of the bad responses, the following presentation will correct his error. Typically there will be one acceptable answer and two or three bad answers to each question. Often the bad answers were chosen for different reasons. In an arithmetic problem, for example, one bad answer may reflect having subtracted instead of adding, while another of the answers reflects difficulty in the use of "carry". Hence, all bad answers do not lead to the same follow-on help. The help offered is "individualized" in terms of the type of difficulty the student seems to be having.

In controlling other media, such as a slide projector, tape recorder or movie projector, the Didactor places them into a form of operation which makes the materials contained on them capable of being picked out at random. That is, since the essence of individualizing instruction is to give only presentations that help one particular student, it naturally means that there must be a large store of presentations in a program from which the necessary presentations are to be chosen. In computer parlance this is referred to as random selection. If other media, such as slides and taped sound, are accompanying a random-selection type of controller, then the material in these, too, must be randomly accessible. Our Didactor provides this capability.

There is no special restriction to application. The individualized instruction I have been working with ranges from using the system in the first grade of elementary schools to medical schools. The system is basically a teacher-saver, for it gets across routine instruction of all sorts about as well, perhaps even better, than a teacher can or at least normally will do. It takes about one-third the time a student would spend getting the same material in a classroom. The boon to the teacher is the fact that students come out of such learning experiences better equipped for class discussion and lab work. The teacher can plan to share more knowledge in-depth with the class without being concerned about their relative states of preparedness.

An interesting study was made comparing two groups of twenty students where one group studied multiplication and division of fractions by Didactor while the other studied in class under a teacher. Both groups came out with equivalent final test scores. The cost to teach the individualized-instructed group was $4.40, the cost to teach the class-instructed group somewhat more than $65.00. In other words, it costs 22 cents to teach each student who used individualized instruction, as compared to $3.25 for each student who attended the class.

Our experience with industrial arts indicates that these students have a special inclination towards practical application. In many cases this attitude has caused the student to suffer many deficiencies in basic skills, such as language, communication, math, theoretical science, history and economics. We know, of course, that these deficiencies will greatly delimit his effectiveness in industry. Such a student seems particularly attuned to the regimen of "machine-controlled" instruction. Short programs on various math techniques, shorts on reading development, accounting, economics, can be interjected as the student encounters difficulties in the industrial arts curriculum. At a vocational high school in Ohio, each department, such as drafting, electronics, agricultural mechanics and carpentry, not only has some of its own basic course material handled by individualized instruction, but has also decided to take on some of the remedial educational responsibilities by providing students with appropriate materials. Thus an ag-mechanics student, who is having difficulties because he simply can't work with fractions or decimals, is given short (about 1- to 2-hour) supplementary programmed courses at certain points during his ag-mechanics classes.

As has already been pointed out, the cost factors to do this are considerably lower than establishing remedial classes. This individualized instruction also eliminates the problems involved in fitting remedial classes into a schedule already complicated by extra-length labs and shop periods. Gone, too, is the social stigma attached to those who are grouped together for remedial work. With controlled individualized instruction, the teacher is able to assign to a student who is having trouble a program or programs which will clear up the problem. These programs can be pursued during study hall periods or at other free time in the school library or instructional resource center.

I feel certain that the future will see a great deal more of this type of individualized instruction become a part of the curriculum, particularly in the industrial arts and vocational training, where it has already established its effectiveness.

Mr. Singer is associated with the Didactics Corporation, Mansfield, Ohio.

Improving teacher performance by micro-teaching and video-tape techniques

John D. Jenkins

At the outset let us understand that micro-teaching and video-tape recording are not synonymous. While video-tape recording is quite valuable to effective micro-teaching, it is only a feedback instrument that provides the opportunity for systematic and accurate examination and analysis of the teaching act. Micro-teaching can be accomplished without the use of video-tape equipment.

Micro-teaching. It might be useful to present a description of micro-teaching as it is most commonly conceived so that we may have a frame of reference from which to communicate. Micro-teaching is a method used with teachers or prospective teachers to provide them with the opportunity to examine the teaching act on a scaled-down level. That is, they work with a reduced presentation time and with a fewer number of students than is normally found in a typical class. A typical teaching act consumes from five to twenty minutes, and the number of students in the group would range from three to ten. The micro-teacher concentrates on a specific teaching skill or teaching behavior, such as questioning, reinforcement, or varying the stimulus. After the teaching act, the micro-teacher's performance is immediately evaluated. This is often done by using a video-tape recorder because it provides certain advantages over direct observation. Student appraisal of the lesson is also used in the evaluation. In fact, student evaluation has been found to be more reliable than supervisor evaluation. The evaluation session sensitizes the micro-teacher to strong elements of the performance as well as to the weak features. He revises the presentation on the basis of this feedback. He then reteaches the revised presentation to a different group of students and goes through the same cycle until he has developed a high degree of proficiency with the particular teaching skill or teaching behavior.

There are many valid criticisms of the micro-teaching technique, as I have described it, but there is little question whether effective micro-teaching changes teacher behavior. In nearly all cases where controlled micro-teaching has occurred, there is a measurable improvement in teacher performance over teachers who have not been exposed to micro-teaching. Some of the primary criticisms are:

(1) Expense of the equipment and the facilities required to conduct micro-teaching experiences if video-recording is used.

(2) Required one-to-one ratio of supervisor to micro-teacher.

(3) Problems encountered with obtaining an adequate number and kind of students to conduct the micro-teaching.

Before I forget it, I would like to emphasize that micro-teaching or variations of micro-teaching and video-tape recording can and should be used in both pre-service and in-service teacher education. For the most part, these methods are being applied exclusively in undergraduate teacher education programs. But wouldn't it be wonderful if schools or school systems had a micro-teaching laboratory to be used by teachers to improve their teaching skills? In many respects, such an arrangement would solve most of the practicality criticisms advanced at micro-teaching.

Relatively few teacher education programs are using the true micro-teaching system in their situation because of the limitations previously mentioned. However, many schools are incorporating features of the micro-teaching system into their teacher education programs. I submit that this condition might be the most significant contribution that will result from the development of the micro-teaching technique. For example, educators have, as the result of Dwight Allen's work with micro-teaching:

(1) Attempted to identify finite teaching practices--or a teaching technology.

(2) Increased use of video-tape recording.

(3) Emphasized earlier student involvement with the teaching act to make him better able to cope with the problems of student teaching.

(4) Developed more effective techniques for evaluation and analysis of the teaching act.

Variations of micro-teaching. At this point let us change our trend of thought from micro-teaching to some of the variations of micro-teaching which might be of value in your programs. It would be impossible to describe or even to list all of the possible variations currently being attempted. I am aware of at least five modifications of micro-teaching currently being used at The Ohio State University. In many cases, these procedures could not be considered actual variations of micro-teaching but procedures which incorporate one or more of the elements of micro-teaching. In other situations, procedures have been attempted to reduce the adverse problems of the true micro-teaching situation.

One program attempted to solve the problem of bringing students to the micro-teaching laboratory by taking the micro-teachers to the students. The director of the program arranged for a room in one of the local schools. He used students in study halls as the subjects for the micro-teaching. The experiment yielded results comparable to those in a normal micro-teaching situation, but additional problems were encountered. The program, over a period of time, became somewhat disruptive to the school, and the school could not commit a single room where the video-tape recording equipment would be set up for the entire day. They had to change the equipment to another room during the day and transport and set up the equipment each day. The program was unable to overcome the problem of the one-to-one relationship between the micro-teacher and the critic or supervisor. The program was reluctantly abandoned for another modification.

A technique used by the Faculty of Industrial Technology was to ask cooperating teachers for student teachers to use evaluation instruments similar to those used in a micro-teaching situation with the student teachers. The student teachers selected a particular teaching skill or teaching behavior. The cooperating teacher assisted the student teacher with the revision of the presentation, and the student teacher re-taught the lesson to subsequent classes later in the day. The major problem with the procedure was that there was considerable variation in cooperating teacher evaluation, and there was insufficient opportunity to re-teach the lesson. Some cooperating teachers were reluctant to use the forms, because they did not permit them sufficient opportunity for subjective appraisal of the student teaching performance. However, in some cases, the student teachers and the cooperating teachers felt that the student teachers had made significant improvement on a particular teaching skill or teaching behavior.

We will be attempting to use a modification of the micro-teaching technique with the students in our methods courses. Like many other situations, we will have to use a procedure that is compatible with the resources we have available. Precisely how we will overcome the problems mentioned earlier remains to be seen.

For example, we have two staff members working with about sixty students. A normal teach-evaluate-re-teach cycle could take about two hours before the student attains any degree of proficiency with a skill. That means each professor will have to spend about sixty hours in a ten-week period to help all thirty of his students attain skill in only one teaching behavior. That constitutes about twice the normal contact load currently being devoted to the class. It is obvious that certain adjustments will have to be made to accommodate the quantity of students. It should also be remembered that any changes in the procedure result in a reduction of the quality of the control situation.

You might have the idea that I am anti-micro-teaching at this point. On the contrary, I am enthusiastic about any technique that will assist us in preparing better teachers. I do question the practicality of micro-teaching without sufficient resources. Stated another way, there is some question as to whether the gain achieved through micro-teaching is worth the expenditure of resources required to operate a first-class operation. In addition, much research needs to be performed to determine whether modification of the micro-teaching technique actually improves teacher behavior.

Video-tape recording. Now for a brief examination of video-tape recording and its application to improving teacher performance. In the early phases of closed-circuit television, primary emphasis was directed at using television as a means of transmitting information. This kind of activity continues, and there are some distinct advantages to the method.

It has only been recently that educational institutions have even considered the purchase of closed-circuit television equipment. This was essentially due to the expense of earlier equipment. Today portable units, capable of recording excellent images and sound, are relatively cheap, and many schools have at least one set available. But the primary use of the television equipment continues to be for imparting information to children.

At this time I would like to direct your attention to a different use of closed-circuit television. That is, let us look at it as a tool, a recording device, an instrument capable of capturing and preserving the teaching act.

As I said before, I believe that one of the most significant outcomes of the micro-teaching movement will be the use of television to examine teaching behavior and to improve the quality of teaching. You might say that teachers have been observed and evaluated for years, and this technique doesn't really add anything new to that situation. I suggest that there are several extremely positive potential outcomes which are available because of video-tape recording.

The first and foremost outcome is that the teacher or prospective teacher is now able to see himself as others see him. This in itself is a traumatic experience for many people, but the outcomes can significantly outweigh the anxiety.

For example, people, by their nature, do not like the thought of admitting their inadequacies. When a supervisor makes an evaluation of an observation, a teacher is often reluctant to accept the judgments and suggestions of the supervisor. He activates defense mechanisms to prevent him from coming to grips with the problems. He might say to himself, "The supervisor is in a bad mood today and if he made the observation another day, he would see things in a different way." Another might be, "The supervisor is trying to impose his value judgments on my performance."

Now consider the same teacher in a situation where he has been video-taped and the supervisor has made no value judgments. When the recording is played, the teacher has no place to hide. He is less likely to rely on defense mechanisms to explain away inadequacies in his teaching performance. Some educators advance the hypothesis that teachers become more objective because they believe they are evaluating a tape and not themselves.

A second outcome of video-tape recording is that selected portions can be examined several times. This can and should be used to emphasize strong features of the teaching episode as well as to identify areas for improvement.

A third outcome is that teachers have the opportunity actually to see improvement. An early recording can be saved and later compared with a tape that shows improvement. If a teacher can see improvement, he is more apt to continue to want to improve. When he is unable to see improvement, he is likely to become discouraged and give up.

The fourth desirable outcome of video-tape recording is that teachers can evaluate themselves or team up with peers for evaluation. We all know that supervisory personnel do not have the time, in most cases, to help teachers improve their instructional techniques. By using the video-tape recorder and helping the teacher learn how to analyze and evaluate teacher performance, he can do the evaluation himself. A student or another teacher could operate the equipment and record a lesson. At least in the near future, teachers are going to have to rely on self-evaluation if they want to examine and improve their teaching performance.

There are certainly additional favorable outcomes from the use of video-tape recording that could be identified, but the list just mentioned identifies some major points. I should caution you that you are working with human behavior, and it is often difficult to predict results of a particular treatment. Some individuals respond immediately to such situations, and others are reluctant to participate.

We at The Ohio State University are vitally concerned with helping our teachers to become concerned with perpetual self-improvement, because there has traditionally been very little help for the teacher after he enters the classroom. Considerable emphasis is placed on providing the teacher with some of the tools that he can use for self-improvement.

One such technique employed is the use of the portable television unit. Each quarter the student teachers are taped in a presentation situation. We feel that this accomplishes several ends. Some of them are:

(1) The student teachers reduce their fear of having their inadequacies exposed.

(2) The student teachers have the opportunity to see themselves as others see them --in other words, self-perception.

(3) They learn some of the elements that constitute a good and a poor presentation.

(4) They become more objective evaluators because they are expected to evaluate themselves and their peers, using both written and oral techniques.

This technique has met with a high degree of acceptance with the student teachers. Invariably, the response in the final evaluation of student teaching, made by the student teachers, is that they would have liked to have had more experiences with evaluating their performance using the video-tape recorder. I might add that most of the student teachers are terrified just prior to the first time they are taped. This would seem to indicate that acceptance of evaluation is quite rapid at this stage in teacher preparation. There is evidence to indicate that experienced teachers are less likely to accept this type of evaluation and remain quite tense after several sessions.

This entire discussion seems to have two primary underlying assumptions that have not been previously mentioned. In closing let me state them, because it seems to me that you have to accept them before you can accept micro-teaching or variations of micro-teaching or the use of video-tape recording for improving instruction. They are:

(1) There is a set of teaching practices that can be identified. That is, just as a physician or surgeon has a set of practices he uses to cure people, so does the teacher have a set of practices for helping children learn.

(2) People can learn to become teachers. They can be taught to use efficient practices to bring about desired behavior changes in children.

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curriculum development

Basic elements of industry-content enrichment, viewed by an educator

Robert Magowan

If I were an industrial arts teacher in the public schools and were given a list of the basic elements of industry, namely, research and development, production tooling, production control, quality control, personnel management, manufacturing and marketing, I would view these with interest and feel that subject matter in these areas would enhance my program.

My first step in preparing to teach these subject matter areas would be to research each of these elements. As I researched these areas I would then discover that some of the elements, such as manufacturing, marketing, and research and development, were very broad in nature, while others, such as production tooling, production control and quality control, were more narrow and specialized. I would also find other topics, such as product design, plant layout, process design, maintenance, accounting, budgeting, etc.; and I would wonder how these would fit into the list of basic elements of industry. At this point I would probably be so confused that I would either forget the whole idea of incorporating this material in my program or I would attempt to develop a more appropriate listing of the basic elements of industry.

I trust that when we are referring to industry, we are discussing those manufacturing industries that produce a salable product. It would then appear that if we listed the very basic elements of this type of industry we would include three elements: Sales, production and finance. Any manufacturing industry must first produce, and it must then sell the product, but it must also have adequate finances and financial controls. Below is a listing of these basic elements and also some of the possible sub-elements that would be included. An asterisk is placed by each of those elements suggested by the committee directed by Dr. John L. Feirer.

SALES

1. Direct Sales
*2. Market Research
    a. Forecasting
    b. Market trends
3. Advertising

FINANCE

1. Accounting
    a. Cost
    b. General
    c. Payroll
2. Budgeting
    a. Capital
    b. General
    c. Operating
3. Internal Auditing

PRODUCTION

1. Product Design
    a. Styling
    b. Mechanical
    c. Research & Testing
*2. Research & Development
    a. Product improvement
    b. New products
    c. Pure research
3. Industrial Engn.
    a. Plant layout
    b. Process design
    *c. Tool design
    d. Time studies
*4. Personnel
    a. Employment
    b. Labor rel.
    c. Training
    d. Safety
*5. Prod. Control
    a. Scheduling
    b. Dispatching
    c. Inventory
*6. Quality Control
    a. Inspection
*7. Manufacturing
    a. Fab.-assembly
    b. Packaging
8. Maintenance

The listing of sub-elements is by no means exhaustive of the items that could be included, but it does indicate what I regard as the basic structure and many of the elements of industry.

It would be highly desirable to include these elements of industry in the public school industrial arts curriculum. The common industrial arts program is perhaps exposing students to some of these elements, but I seriously doubt if many of these topics are currently being included. The arts of industry do not only include the fabrication and assembly of a product but also many other areas as evidenced by the above structure. If the student is to grasp the total concept of our manufacturing industries, he must be exposed to each of these elements.

I do foresee problems, however, in attempting to integrate these elements into the public school industrial arts curriculum. Any one industrial arts teacher will not be familiar with all of the areas of industry. He was probably not educated to teach this subject matter, nor was he even exposed to many of these topics during his training. How then will he be able to teach these basic elements of industry?

To introduce current industrial arts teachers to these factors of industry, I would suggest various types of training programs, such as summer workshops and institutes. The individual teacher must also be encouraged to study on his own time and gradually include more of this industrial information into his curriculum.

Teacher education programs across the nation can also aid in this endeavor. They should design their programs so that prospective industrial arts teachers are exposed to these elements.

The suggestions I have made will not be easy and will not be readily accomplished. However, if these elements are included in industrial arts programs, the curriculum will undoubtedly be enriched.

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Man, technology and manufacturing

Donald F. Hackett

The story of man, his origin and rise to dominance on earth is told in many ways. But as scholars probe the earth and piece together bits of information, a certain consistency or uniformity begins to appear in the story. When viewed in relationship to our present-day programs of industrial arts, some glaring inconsistencies arise. The purpose of this paper is to point out some of these inconsistencies and to suggest an approach that more nearly meets the educational needs and interests of youth in the twentieth century.

Man's origin will continue to be debated for all time. But, for the purposes of this paper, the debate is purely academic. However, the evolutionist's explanation of the origin of man does fit the need of the moment, since it introduces the concept of technology as the force and the instrument which made man and enabled him to reach his present level of achievement. Consequently, this story, this rationale, begins with that theory.

Washburn, in reporting on the origins of man, states that:

> It was the success of the simplest tools that started the whole trend of human evolution and led to civilizations of today. ...Now it appears that man-ape creatures able to run but not yet walk on two legs, and with brains no larger than those of apes living now – had already learned to make and use tools. It follows that the structure of modern man must be the result of the change in terms of natural selection that came with the tool-using way of life. ...Tools, hunting, fire, complex social life, speech, the human way and the brain evolved together to produce ancient man of the genus Homo about half a million years ago.(1)

In short, when man-ape creatures stood up so they could better use tools, they laid the foundation for the evolution of Homo sapiens, modern man. Man is, therefore, a product of technology.

The Biblical Book of Genesis may describe this process as the work of the Creator on the sixth day. And, when it goes on to state, "...He rested on the seventh day from all His work which He had done", we might assume that the intent was for man to carry on the Creator's work. In any event, man set out upon the eighth day to change the world.

For 99 percent of the time that he has existed, man lived in the Stone Age, so-called because his principal tool-making material was stone. Being rational, he undoubtedly transmitted the knowledge of his means of survival to his young. If it was otherwise, man would have disappeared from the earth long ago, for he is among the weakest of creatures. However, by virtue of his rational powers, his capacities for tool-making and using, for creating, inventing and building, man raised himself to the position of the dominant creature on earth.

Man invented agriculture about 8000 years ago when he learned that animals could be domesticated and that seeds could be planted, grown and harvested. This great discovery permitted him to cease his nomadic, food-gathering ways and to settle down in one spot. His shelters took on a degree of permanence, children became an asset, and his life expectancy increased to 35 or 40 years.

In his new way of life, man found time to provide certain conveniences. He wove fibers into cloth for clothing. He produced pottery so he could cook and store his food and drink. He became a metallurgist and produced better tools for both peace and war. He traded his goods and devised improved ways of transporting them. He built cities and formed governments. Man was civilizing himself as he learned to develop and employ technology.

Reading and writing originated in the priesthood of ancient Egypt. The priests collected, stored, sacrificed and doled out the food and other goods delivered to the temples. To facilitate their record keeping, they invented a system of picture writing – hieroglyphics. The Phoenicians simplified this system by developing a series of letter symbols. The Greeks adapted it to their use and the Romans, in due course, passed it on to Western cultures.

During early Grecian times, the ability to read and write was associated with those who did not draw water and hew stone. Aristotle and Plato admonished boys to learn to read and write so they could wear a white toga and be spared the soil and toil of work. "Even Archimedes, popularly acclaimed for his remarkable mechanical inventions, appears to have been ashamed of his interests in such work. He apologized for them, claiming they were carried out merely for his diversion and amusement."(10)

The Roman world showed more interest in technical achievement than did the Greek. However, while their accomplishments in road building and architecture are noteworthy, the Roman mind did not value the qualities necessary for continued technological advance. The Romans were technologically sterile; their fame rested largely on conquests, law and administration.

As the Western World developed, technology was applied through handicraft to the production or manufacture of goods. The craftsman, however, was frequently considered subordinate to the artist, statesman, theologian and nobleman – all relative newcomers to the scene of man civilizing himself. Despite his importance in developing the culture that made such pursuits possible, the craftsman-technologist was never accorded a dominant role in the social organization of the time. And, when money lending and banking became honest pursuits, even the ownership of his enterprise passed from him to others.

When formal schooling began, its sole function was to prepare one for a life of contemplation, leisure and luxury. It was provided for and limited to children of the wealthy. Children of the masses grew up with little or no formal schooling. A select few did, however, learn the 3 R's and the secrets and mysteries of a craft through apprenticeship. Consequently, it was natural that education and security, wealth and leisure should assume a cause-and-effect relationship in the minds of people.

Public schools were established about a century and one-half ago, so that all children might realize "the better life" through education. The curriculum was essentially that of the old liberal arts schools, and it carried the blessings of most educators and parents. However, some individuals questioned the relevance of this program of studies. The history of education is replete with accounts of their proposals, experiments and innovations to this end.

About a century ago a humanistic element was added to the school program to assist the young in adjusting to their social environment. Around the turn of this century a scientific element was introduced to enable children to understand and adjust to their physical environment. The developments in science that led to its inclusion in the school program were paralleled by the most remarkable industrial-technological development the world had ever seen. Yet, efforts to introduce this element into the school met with limited success or outright opposition. Even Federal participation in the form of funds for vocational education did little more than divide the school into two camps.

Technology has been the dominant influence in the process of man civilizing himself. Without it, we would still be swinging from trees by our tails. Technology dominates our lives. Our culture is distinctly technological. Yet our school programs fail to reflect technology and the resultant organization of work that makes our culture what it is.

Peter Drucker refers to this discontinuity on the contemporary scene when he states that:

> ...the new technologies are not based on science alone, but on new knowledge in its entirety (and) means that technology is no longer separate and outside

> of culture, but an integral part thereof. Civilization has, of course, always been shaped by technology. The notion that technology has become important only during these last 200 years or so is errant nonsense. Tools and the organization of work -- the two elements of what we call technology -- have always molded both what man does and what he can do. They have, very largely, determined what he wants to be. Still, for several thousand years -- in the West ever since the Greeks made slavery into an economic institution and into the foundation of production -- work, and with it its tools, methods and organization, have been considered outside culture and unworthy of the attention of a cultured person.(2)

Drucker explains the new technology when he says:

> The technology of the twentieth century embraces and feeds off the entire array of human knowledges, the physical sciences as well as the humanities... the split between the universe of matter and the universe of mind -- the split introduced into Western thought by Descartes 300 years ago -- is being overcome.... Equally important and equally new is the fact that every one of the new emerging industries is squarely based on knowledge. Not a single one is based on experience. ...they will employ predominantly knowledge workers rather than manual workers.... The productivity of the worker will depend on his ability to put to work concepts, ideas, theories -- that is, things learned in school -- rather than skills acquired through experience.(3)

This Nation's schools have, since the early part of this century, professed a concern for introducing the young to their culture. Statements of objectives commonly refer to this over-all goal and to that of economic efficiency. Yet, many schools have, in purporting to transmit our culture, neglected the very essence of both man and culture -- technology and the consequent world of work. Instead they have fed youth a pablum of facts and fancies, almost completely divorced from the needs and realities of contemporary culture. The effects are reflected in the number of school drop-outs, in limited student achievement and in growing unrest among students.

Industrial arts is a means to advance technology -- if it is so structured. The industrial arts of past decades is not the answer. This tool skill - project oriented approach was reflective only of the 19th century in which it had its origin; it failed to reflect the tool making, inventive, rational nature of man. Therefore, a "new industrial arts" is necessary to begin to fill the void in present-day education.

An industrial arts to reflect technology was first suggested by William E. Warner in the 1930's. An array of research has since provided an organization and structure for a new industrial arts - one that aids in developing in youth the distinguishing qualities that make man human.

This new industrial arts is defined by Delmar W. Olson as follows:

> Industrial arts is a study of the technology, its origins and development; its technical, consumer, occupational, recreational, social and cultural nature; and its influences through experimenting, creating, designing, inventing, constructing and operating with industrial materials, processes and products. Its purposes are to acquaint the student with his technological environment and to aid him in the discovery and development of his own human potential.(4)

Olson's definition of industrial arts as a study of technology includes the delimiting term "industrial". This is necessary for at least two reasons. First, industry is perhaps the prime means to today's technology, as it is the producer, the creator of the technology that has come to occupy an ever-increasing place of importance in the social, economic and political aspects of life. Secondly, technology is too vast a discipline for competent treatment by any one sector of the school. Its very nature dictates that every subject reflect technology.

The term technology originated in the Greek words "techne" meaning art or skill and "logia" meaning study. Thus we get the dictionary definition of technology as the science or study of the industrial arts (arts of industry).

Dewhurst and the Twentieth Century Fund state:

> As technology consists of accumulated knowledges, techniques and skills, and their application in creating useful goods and services, the ultimate fruits

> of a country's technology are found in the standard of living its people are able to enjoy. ...Technology, in fact, can be thought of as the primary resource; without it all other resources would be economically nonexistent.(5)

Kranzberg (6) states that:

> While the influence of technology is both widespread and fundamental, the term cannot be defined with precision. In its simplest terms, technology is man's efforts to cope with his physical environment -- both that provided by nature and created by man's own technological deeds, such as cities -- and his attempts to subdue or control that environment by means of his imagination and ingenuity in the use of available resources.... In the popular mind, technology is synonymous with machines of various sorts -- the steam engine, the locomotive and the automobile -- as well as such developments as printing, photography, radio and television.... Technology, then, is much more than tools and artifacts, machines and processes. It deals with human work, with man's attempts to satisfy his wants by human action on physical objects.

Technology, then, is the composite of man's achievements with mind, materials, energies; it is man as he controls and uses nature; it is man creating his own environment; it is man civilizing himself. Technology includes agriculture, industry (manufacturing), medicine, services, construction, transportation, mining, management, homemaking and every other way in which man contributes to his wants.

At the present time, no school and no school subject is prepared to introduce the total of technology to its students. However, this condition will come to pass as educators develop an awareness of the impact of technology on human affairs everywhere. Then, and then only, will technology adequately and successfully attain its rightful position with the sciences and humanities in the school program. For the time being, industrial arts can begin to provide this element in the school. In due time the other subjects will follow.

Industrial arts, as a study of technology, is herein limited to that sector of technology popularly called industry. Olson(7), DeVore(8), Face and Flug(9), and other researchers have produced works giving substance to this decision. Analysis of their studies and of American industry reveals a general nature, breadth and depth of industry that may be grouped into eight categories: manufacturing, construction, communication, transportation, power, services, research and management. These groups are assumed to account for all of American industry and to provide the essentials for a curriculum in industrial arts.

Educational objectives commonly deal with: Competencies in communication; learning how to learn; understanding the world and man; activities of citizens; ability to care for mental and physical health; sensitivity to and understanding of aesthetics; and specialized interest. Industrial arts can contribute to each of these objectives, as can the other school subjects. However, because of its nature, industrial arts provides a different medium for developing these competencies and understandings in students. Furthermore, it can make several unique contributions when it is designed to:

(1) Develop insights and understandings of industry and its technology in our culture.
(2) Discover and develop interests and capabilities of students in technical and industrial fields.
(3) Develop the ability to use tools, materials and processes of industry safely to solve technical problems.

The foregoing objectives of the school and of industrial arts may be analyzed for the purpose of identifying the kinds of behavior the students should exemplify. In so doing it becomes evident that every student should develop an ability to:

Read
Write
Compute
Organize
Interpret
Study
Analyze
Plan
Cooperate
Create
Judge
Describe
Demonstrate
Define
Participate

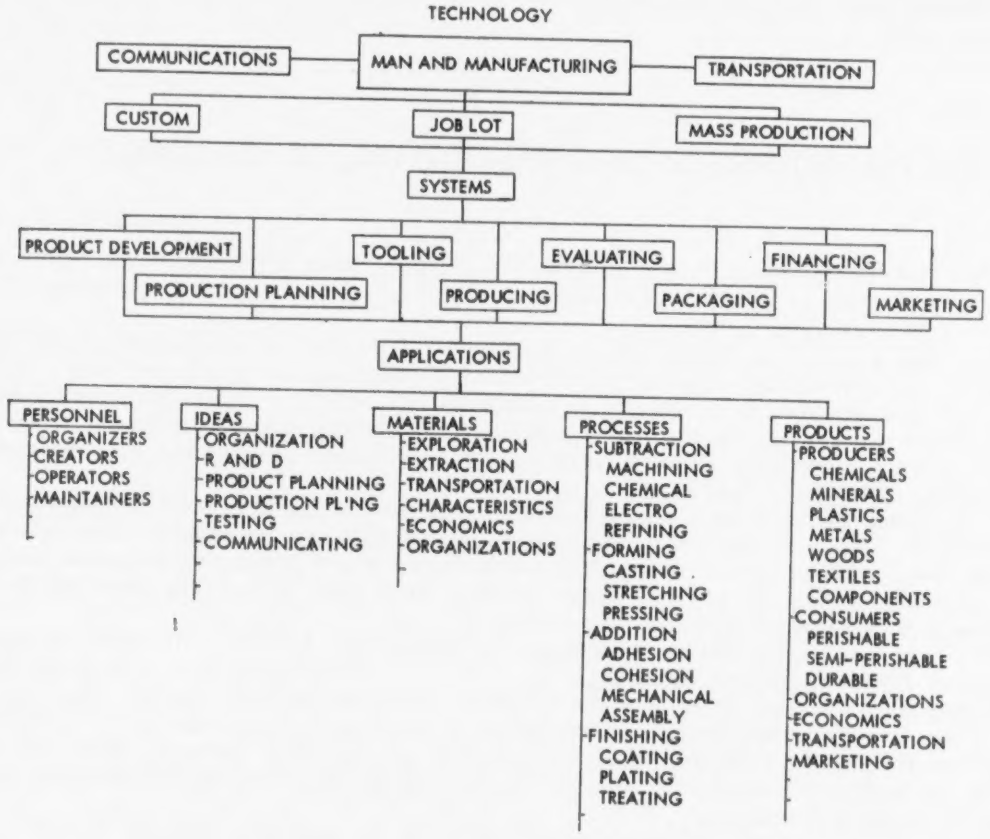
These are some of the competencies that should be developed in all students in any and every school subject, including industrial arts. However, industrial arts students should also develop the abilities to:

Design
Invent
Engineer
Depict
Experiment
Develop
Display
Test
Manage
Diagnose
Sketch
Manipulate
Operate
Disassemble
Assemble
Maintain
Install
Adjust
Produce
Compare
Construct
Cut
Shape
Form
Finish
Schedule
Control
Procure
Measure
Evaluate

These, then, are keys to the kinds of activities that a good industrial arts program will provide. They are the kinds of behavior, skills, that are held to be perpetually salable. They may be developed in schools. The need and demand for people with these basic skills will never cease; they are universally applicable.

Subject matter is the medium for transmitting these skills. It may be selected for its interest value alone, for its need in specific applications or for a combination of both. Teachers, therefore, need to select the subject matter which best fits the nature and needs of their students as well as the needs of society.

One approach to a course in "manufacturing" provides a study of man using and developing technology to convert the earth's natural resources into man's material welfare. It is designed to develop an understanding of the principles and concepts involved in the "systems" of manufacturing. The major industrial tools, materials, processes and problems are studied. Experiences are provided in organizing a manufacturing enterprise and in producing and marketing a product. This simulated work experience affords the student an opportunity to test his interests and capacities in four occupational categories. Furthermore, it assists the student in becoming aware of his strengths and weaknesses and in realizing a value in other school subjects. (See the model "Man and Manufacturing".)


TECHNOLOGY
COMMUNICATIONS
MAN AND MANUFACTURING
TRANSPORTATION
CUSTOM
JOB LOT
MASS PRODUCTION
SYSTEMS
PRODUCT DEVELOPMENT
TOOLING
EVALUATING
FINANCING
PRODUCTION PLANNING
PRODUCING
PACKAGING
MARKETING
APPLICATIONS
PERSONNEL
ORGANIZERS
CREATORS
OPERATORS
MAINTAINERS
IDEAS
ORGANIZATION
R AND D
PRODUCT PLANNING
PRODUCTION PL'NG
TESTING
COMMUNICATING
MATERIALS
EXPLORATION
EXTRACTION
TRANSPORTATION
CHARACTERISTICS
ECONOMICS
ORGANIZATIONS
PROCESSES
SUBTRACTION
MACHINING
CHEMICAL
ELECTRO
REFINING
FORMING
CASTING
STRETCHING
PRESSING
ADDITION
ADHESION
COHESION
MECHANICAL
ASSEMBLY
FINISHING
COATING
PLATING
TREATING
PRODUCTS
PRODUCERS
CHEMICALS
MINERALS
PLASTICS
METALS
WOODS
TEXTILES
COMPONENTS
CONSUMERS
PERISHABLE
SEMI-PERISHABLE
DURABLE
ORGANIZATIONS
ECONOMICS
TRANSPORTATION
MARKETING

The main purposes of this study are: (1) to afford all boys and girls an opportunity to learn about the industrial-technological complex outside the school; (2) to provide an opportunity for these students to explore a large group of industries and occupations in our culture and to make tentative occupational choices (with the help of counselors) that reasonably reflect their capabilities, interests and aspirations; and (3) to assist them in developing a degree of skill in using industrial tools, materials and processes in solving technical problems.

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Introduction to manufacturing technology

Talmage B. Young

What I shall say is a report of an experience which I have just completed. I have no intention of dealing in philosophy, economics, sociology or pedagogical "gobbledegook". I will attempt to tell you "like it is".

Two basic needs motivated this experience. Perhaps the most important was to evaluate a conceived program under actual teaching conditions. As you know, the average industrial arts teacher is skeptical of "ivory tower" programs from the universities. To avoid this skepticism, it is important to know whether a program can be operated under actual teaching conditions. Too, it is necessary to discover problems so that solutions can be found and refinements made.

The second need was for a renewal of experience with children in the teaching-learning situation. As a teacher educator, I was not sure that my experiences of 1946 were valid for today. I found some difference in that today's child is more sophisticated, knows more and has wider interests. Their inability to be still, their exuberance and their penchant for "horseplay" are about the same.

The program, conceived as manufacturing technology, focuses upon those concepts which are common to manufacturing. No attempt is made to simulate line production completely in its complexities, but the emphases are upon those principles which are a part of any manufacturing process – from single-item production by hand to the complete production by programmed machines. Although a general shop was used, there was no attempt to utilize all materials areas. The materials used were chosen as those best suited to the product design.

The first product was called a "cord winder" by the students, although it was used only as a focus for a teacher-structured teaching device to provide a basis for planning more advanced products. The process involved consisted of both demonstration and discussion as outlined below.

I. Introduction to product
   1. Show how it is made
      a. How to measure
      b. How to square to dimension (what square means)
      c. How to cut with a handsaw and backsaw
      d. How to mark hole locations
      e. How to stop a bit for depth of cut
      f. How to check for squareness of bit or auger to stock (two directions)
      g. How to gauge for accuracy and acceptability of a product
   2. Construction of item by hand and by machine
      a. Each student constructed one item by hand (a time clock for time measurements).
      b. Twenty items were constructed on variety saw and drill press, using stops and simple jig by two selected students (also timed).
      c. Comparison of time, efficiency, accuracy, etc.
      d. Comparison of cost per acceptable item
   3. Evaluation of process - discussion of processes, accuracies, costs, discussion of standardization, interchangeability, etc.

II. The second product was a napkin holder which was planned with the class. This product involved:
   1. Jointing
   2. Facing
   3. Resawing
   4. Planing
   5. Cutting to length
   6. Use of jig to cut angles
   7. Grooving
   8. Sanding (machine and hand)
   9. Glueing
   10. Staining
   11. Using brushing lacquer
   12. Process evaluation

III. The third product was a dresser valet. It involved:
   1. Planning
   2. Facing, resawing, planing, jointing, ripping, cutting to length
   3. Pin-routing to pattern
   4. Face glueing
   5. Sanding
   6. Finishing
   7. Glueing of felt to wood
   8. Bending (1/8 rod on DiAcro bender)
   9. Drilling to dimensioned position (jig)
   10. Evaluation

IV. The fourth product was a pair of salt and pepper shakers. This involved:
   1. Planning
   2. Planing
   3. Jointing
   4. Ripping
   5. Resawing
   6. Routing on pin-shaper to pattern
   7. Shearing to dimension (stainless steel)
   8. Drilling, use of jig
   9. Punching
   10. Bending, barfolder
   11. Assembly with silicone rubber

12. Sanding
13. Masking with masking tape
14. Finishing
15. Evaluation - discussion

In each of the above projects, students were given more and more part in planning and execution of the product. In the fourth project, two student foremen assumed the responsibility for directing the project. This series is followed by a student-planned product of his own choosing.

Several features of the rationale used in this program are: (1) The educative process moves from a learning task completely established by the teacher to a point of semi-independency of the student; (2) emphases are upon manufacturing principles and not on materials; (3) the products are of commercial quality; and (4) student planning is based upon prior experience and information, (5) mutual interest and motivation are used in teaching to classes or groups of students; (6) activity in the laboratory begins as early as possible; (7) materials or shop areas are the means for teaching – not the subject to be taught; (8) the why is emphasized as much as the how; (9) emphases are upon democratically-shared decisions, mutual cooperation and objective evaluations of work; and (10) needs are created for information and skill before teaching is attempted.

Several problems were found in the structure of the program and solutions were developed. These are listed below.

Problem	Solution
1. Students with periodic idle time.	1. Devise short-term projects and problems which require very little instruction for these students. For example: laminations, ceramics, programmed drawing, etc.
2. Not enough operations to employ all students	2. Divide class into two or more groups. Use two products and alternate.
3. Product selection	3. Have students use pictures from catalogues, magazines, etc.
4. Machine limitations (bottlenecks)	4. Construction of simple machines, such as cross-cut saw with non-tilting arbor and limited vertical adjustment, small sheet metal brake, disc and drum sanders, etc.
5. Jigs and fixtures	5. Constructed by students and teacher. Students should do so if time can be managed.
6. Evaluation for individual grades.	6. Have students assemble and finish their own productions in some cases. Observations of cooperation in work. Tests for understanding.

SUMMARY.

(1) The process described is productive in learning and in the realization of objectives of industrial arts as general education.

(2) The process seems to be more efficient for teaching in that the subject of discussion is common to all students.

(3) The operational aspects provide for a greater flexibility in that students of all ability levels can perform some part of the activity.

(4) The process is conducive to the development of cooperation, group problem-solving, and objective assessment of outcomes.

(5) Peer pressures rather than teacher pressure control class conduct and attention to detail in the productive processes.

(6) Some students show a clear understanding of the total process, while others see only narrow details. (Perhaps this is an additional problem to be solved.)

(7) There is a need for small, inexpensive, machinery to supplement the standard equipment of the laboratory.

(8) Many teachers need work in developing the skills, the teaching techniques, and a better background in economics, sociology and industrial history to do outstanding teaching in this approach.

(9) Test materials for this level of education, which are nonexistent, are needed.

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"Wrind Unlimited"

Bob Cawley

Finding the best way to teach industrial arts by the most accepted definition can sometimes be difficult.

I have found through four years of research and development what I believe to be the best way for students to learn about the "World of Work".

I have my students literally become theatrical actors, assuming positions of a typical industry or manufacturing concern. The student creates an industry, such as the title of this article, and establishes an effective industrial organizational chart. When the chart has been established, job descriptions and definitions are prepared by the instructor and are given to the students.

Once the manufacturing unit has been started, a vice-president of personnel is elected by his fellow classmates. Once elected, he develops a suitable employment application form, and has his fellow students apply for the positions for which they would like to work during that manufacturing unit. The vice-president of personnel develops interview sheets and interviews prospective employees. He grades them on how well they conduct themselves during the interview. When all interviews are completed, he then hires the best-qualified student for each position established in the industrial organization chart.

Once hired, the employees get down to work. They must decide from the gathered information what to do and how to do it. Of course, this requires a meeting of all vice-presidents, department heads and sometimes outside consultants. Enthusiasm becomes a driving force for the students, who are proud of the job they are doing.

At this point, the research department, by taking several surveys, decides what the company is going to make. They then develop the idea into a workable plan and turn the information over to the other vice-presidents.

The production department develops the plans and obtains the materials at the best price of the object to be manufactured and figures how much profit must be made in order for the company to stay in business on a productive basis. The marketing department assumes responsibility for advertising and sales promotion. The legal department develops stock shares, warranties and sales contracts. The external relations department places the company's image before the public.

Once all the planning has been done in Plant A, then all the plans are sent to Plant B. In Plant B, new positions are assumed by the employees of Plant A. In Plant B, the plans for the product to be manufactured are finalized so that it can be mass-produced using industrial techniques, tools and materials.

By using the two-plant method, students not only learn how to mass-produce an object, but also how stocks are bought, sold, how profits are figured, how advertising sells the product, etc. These areas would never be covered if we as industrial arts teachers only taught how to run machines and how to figure the cost of an object to be made as a project.

What better way can we teach about consumer knowledge, vocations, and how all the areas fit together to form the whole industrial complex than with a unit on manufacturing?

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A seventh-grade industrial arts curriculum

Michael Hacker

In the summer of 1967, a new industrial arts curriculum was written by three members of the teaching staff for seventh-grade students in Syosset, Long Island. This curriculum is now in its third year, after having been implemented in September, 1967. The aims of this new program are to create a better understanding of the tools, materials and processes of industry; to teach how to organize operations more efficiently; and to elevate the image of the subject as viewed by the student body, their parents and the school administration.

These aims are not radically different from those that have been claimed as goals for traditional industrial arts programs in the past; however, the industrial arts department hoped for better results than past approaches have yielded.

This new curriculum, called Seventh Grade Manufacturing, aspires to accomplish the previously-mentioned objectives by dividing the semester's work into units relating to processes involved in, and methods of, manufacture. This is in contrast to the traditional approach, where students were offered courses in metalworking, woodworking and ceramics for six weeks each, with the emphasis upon the development of manipulative skills in these areas.

The new approach also intends to present a more realistic picture of American industry to the students by devoting more than cursory attention to the various facets of manufacture.

This approach does not pretend to be of completely new fibre, nor do its authors claim that any new earth-shaking theories are involved in its fabrication; rather, this is an attempt to elicit the best possible program from what we now know as good industrial arts education.

We anticipate that not only will the students learn at least as well as they do within the traditional frame, but that there will be more of an opportunity for them to develop problem-solving techniques, and that the children and their parents will come to accept the industrial arts program as a challenging, stimulating and vital facet of the schools' offerings.

Basically, the new approach exposes the Syosset seventh grader to three methods of manufacture:

(1) Limited craft production, where it is the function of one or two individuals to produce an object from start to finish.

(2) The mass production methods of production, where the assembly line, jigs and fixtures, interchangeability of parts, time and costs are stressed.

(3) The automated approach, where the human element is employed basically to design, program and maintain the machinery.

The students are taught the advantages of each approach, and they manufacture products employing the craft and mass production methods.

The students' knowledge of the manufacturing industries would stem from a study beginning with a highly-structured mass production activity, the purpose of which is to illustrate to the students how a rather complex product can be mass produced in a relatively short time, by relatively inexperienced youngsters. By "highly-structured", we mean completely organized by the teaching staff, allowing the students to take part only in the manual operation, not in the planning and designing of the job.

This activity, then, is intended to provide a common experience for all students, which can later be referred to as the study of industry proceeds. The goal of this phase of the course is simply to impart to the children understanding and eventual appreciation of the many operations and steps involved in the organization of the mass production activity.

Drawing from this common experience, and from the knowledge acquired from formal lessons that will be given relative to mass production, it is expected that the students can demonstrate their understanding by implementing a student-organized and -designed line production product, where the class might be organized into the jobs making up a small company.

The children would design, market, engineer and draw plans for the product. They might name their company, sell stock, buy material at the best available price, design jigs and fixtures, and finally run their job.

As it is difficult, almost impossible, for the uninitiated to progress directly from the most simple to the most complex, without intermediate stages, our students must learn how an industry functions before they can collectively act as an industry to mass-produce a product.

It is suggested that the students study the structure of a small industry first, and then they would be in a position to generalize to some degree about a larger organization. The limited craft approach to manufacture is chosen for study, because an individual craftsman performs many of the same operations that a large industry does, and makes many of the same kinds of decisions with which a large industry is faced, only the craftsman does these things on a smaller scale. He must design, plan, research, engineer, determine his market and his costs. After a study of the craftsman's process of manufacture, where some skill in the use of tools is developed through a project manufactured by each individual, the class can approach its mass-production project more intelligently.

A new phase is introduced midway through the year, dealing with the testing of materials. This approach is in contrast to the traditional method of supplying related information about materials in the form of formal lessons, where the students were required to listen and take notes. Here, the activity centers around both mechanical and environmental testing of materials. Mechanical materials testing equipment, such as a universal test machine, can be used to perform tensile, compression, shear and hardness tests. Mechanical testing might also involve tests on fastening devices, such as machine screws, nails, glue joints and wood screws. Insights are thus gained into the properties, uses and limitations of materials.

Environmental tests are performed by subjecting materials to the environment, and after a certain period of exposure, these materials are inspected to determine what effect things like weather, heat, vibration, moisture and so forth have on the sample.

Through our experience, we have found that students of this age level need very little prodding to perform some of the more obviously destructive, yet very informative, tests.

COMPARISON BETWEEN COURSE IN MANUFACTURING
AND A TRADITIONAL METHOD OF TEACHING

	7th Grade Manufacturing	Traditional 7th Grade Course
OBJECTIVES	To provide an understanding of industry. To create an understanding of how operations are organized. To provide a measure of skill in the use of basic tools, machines and equipment.	SIMILAR OBJECTIVES, WITH PRIMARY EMPHASIS UPON DEVELOPMENT OF MANIPULATIVE SKILLS
MATERIALS TO BE WORKED WITH	Wood, metal, plastics, and ceramics will be combined to form the finished project.	Each project made of one material only. Either wood, metal, plastics or ceramics.
ORGANIZATION OF CLASSROOM	Room is called a manufacturing laboratory, where facilities are provided so that various materials can be worked with, and where the relationship among materials in a manufactured product is stressed.	Room is called a shop. Facilities are provided for work to be performed primarily on one material.
TYPES OF TOOLS STUDENTS USE	Basic tools found in industry and in the home. Vacuum forming, injection molding, portable electric tools, labor-saving machine tools such as radial arm saw, table saw, squaring shear, etc.	Usually concentrate on a great variety of hand tools, many of which are outdated and rarely used by industry. Only a few machines are used; usually jig saw, drill press and wood lathe.
HOW RELATED INFORMATION IS PRESENTED	Some formal lessons, but mostly through a materials testing program, where the students learn about the material by manipulating it.	Formal lessons, films, filmstrips.

	7th Grade Manufacturing	Traditional 7th Grade Course
WHAT DETERMINES THE TOOLS THAT ARE EMPHASIZED	Tools are classified as basic when they are fundamental to a variety and a multiplicity of operations. Tools which can perform similar operations on different materials are stressed.	Tools are emphasized when they are needed to complete work on the project. Usually a complete lesson is given on the use of the particular tool to do a particular job on a particular material. Hand tools are thought of as basic because of their simplicity, not because of their industrial applications.
A TYPICAL LESSON IN REGARD TO TOOL USAGE MIGHT BE:	"The use of tools to cut various materials"	"How to use a tin snips to cut sheet metal"
SUGGESTED PROJECTS FOUND IN PRINTED CURRICULUM GUIDE:	Magazine rack-Mass produced - wood and metal Cheese board-Craft approach - wood, metal, plastic Shoji Lamp-Craft approach. Wood, metal, plastic Serving Tray-Craft or Production. Wood and plastic.	WOOD-Airplane, carved tray, birdhouse, "modern ducks" METAL-Ashtray, toys, box CERAMICS-Ashtray, book ends, animal, paper weight
TIME ORGANIZATION:	Students stay with one teacher for an eighteen-week unit in manufacturing.	Students stay with one teacher for either one 18-week unit shop, or for three six-week units, changing teachers as they change shops.

Summary. The purpose of the Syosset manufacturing program was to present a more realistic picture of American industry to students studying industrial arts.

A study was done on the program in order to evaluate its effectiveness; two groups of students were selected for the project. The control group was taught in the conventional manner. The experimental group was taught the new curriculum, called Seventh Grade Manufacturing.

It was hypothesized that the experimental group would display more knowledge than the control group in three ways:

(1) They would know more about the organization of industry.
(2) They would know more about tools.
(3) They would know more about how to organize mechanical operations.

To test these hypotheses, "t" tests were applied to teacher-made tests designed to evaluate the abovementioned items.

Analysis of the data revealed that the new curriculum proved statistically superior on all three counts to the traditional method of teaching the subject.

The findings of this study are encouragement for the establishment of similar programs in other suburban junior high schools. It is suggested that with the growth of such programs, more meaningful industrial arts will be taught to our children.

Mr. Hacker teaches at H. B. Thompson High School, Syosset, NY.

High school industrial arts—applied science and technology

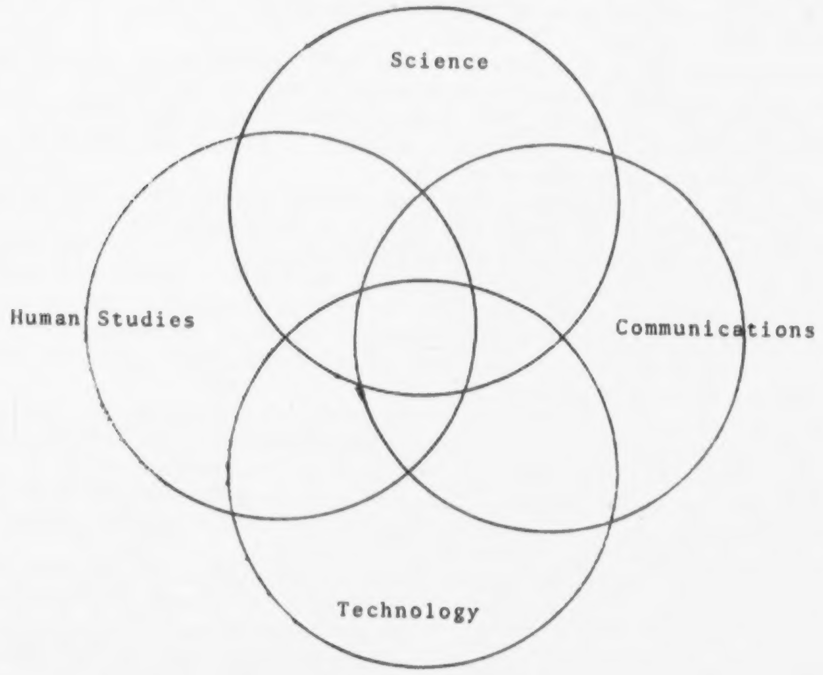
E. Allen Bame and Ben D. Lutz

It is obvious from the title of this presentation that we are from the school of thought that believes industrial arts to be reflective of technology rather than just a study of industry. The terms "Applied Science and Technology" may, to some people, mean the same thing. However, there is sufficient data to justify the inclusion of applied science as a part of technology. Though industry is certainly an important facet of our contemporary society, we in industrial arts must be concerned with the broader aspects of our technical world.

The presentation which follows is twofold: first, the interdisciplinary approach to general education and, second, the intradisciplinary approach to industrial arts.

General education - interdisciplinary. For our purposes, general education may be divided into four bodies of knowledge or disciplines: Science, communications, human studies and technology.

GENERAL EDUCATION



Some typical high school courses, as they could be listed under each body of knowledge, would include: biology, physics and chemistry under the sciences, with the human studies encompassing the social studies, history, humanities, psychology and government. Studies of grammar, literature, foreign languages and mathematics would fall under communications. And technology would include home economics, vocational education, art and industrial arts.

The primary concern of this portion is the fact that, though four distinct bodies of knowledge are shown, they should not be taught as single, autonomous areas of study. The point is, there are many concepts common to all of them that can be taught by two or more disciplines creating a truly interdisciplinary approach.

Traditionally each discipline has tried to stay within what was thought to be its own scope and not to cross over into that of another. Little concern was given to the fact that some topics of study could be better presented by another department or by combining forces.

It must be pointed out that the interdisciplinary efforts discussed here cannot be limited to chance meetings or crossings of interests and needs. This can only result, for example, in industrial arts becoming the place where students make something for other classes. These cooperative efforts must be planned, with representatives of all the bodies of knowledge working together, taking into account the strengths and capabilities of each and transforming these into a total educational experience for the students.

Possibly the best way to explain this is through several examples of industrial arts as it relates to other typical high school courses.

Let's begin with an area of work in the school that is often found to be working with industrial arts – the art department. Art as typically taught in the high school has much that overlaps with industrial arts and is so recognized by many educators, particularly in the crafts and the many facets of design. Often we are asked to assist a budding sculptor as he or she tries to work with a specific material, but this generally is done only as it relates to an isolated case or to a small group of students. Industrial arts educators should have an active role in assisting with the planning of the art curriculum, and the reverse should be true for the inclusion of artists in the planning of the industrial arts program. The casting of metals is one overlapping area which could spark the interest needed to start some students into a learning activity.

Communications can work hand-in-hand with efforts of industrial arts students in report writing, presentation and research studies. The visual communications or graphics area of the typical industrial arts department has much in common with the communications discipline in the school. Combining visual with verbal or written presentations for book reports, essays and creative writing could create new and exciting experiences for students and teachers.

The sciences also offer tremendous cooperative possibilities. Since both organic and inorganic materials are studied, biology, physics and chemistry have a direct interrelationship with industrial arts. For example, the study of solid state materials (or materials science) must include a study of chemistry, and the presentation of power concepts must draw upon the principles of physics.

As for the area of human studies, the most obvious correlation is the common tie of the history and development of technology with all the related social implications of our changing world. Often the humanities classes in high schools are discussing what could be considered to be industrial arts subjects, such as the development of man and his tools, the economic and geographic considerations in locating industries, the social problems caused by industrial waste, styles of architecture, inventions and inventors and so forth. Many humanities teachers are quite surprised when "those 'shop' teachers" know something about and are interested in these subjects.

The important point to be made here is not that there are common areas of interest, but that we are not taking advantage of these commonalities. Our students are not getting the experiences they need for an understanding of today's complex world.

Industrial arts - intradisciplinary. This now leads us to the fact that just as our total educational program needs to be interdisciplinary, there is a need for intradisciplinary efforts within the various bodies of knowledge.

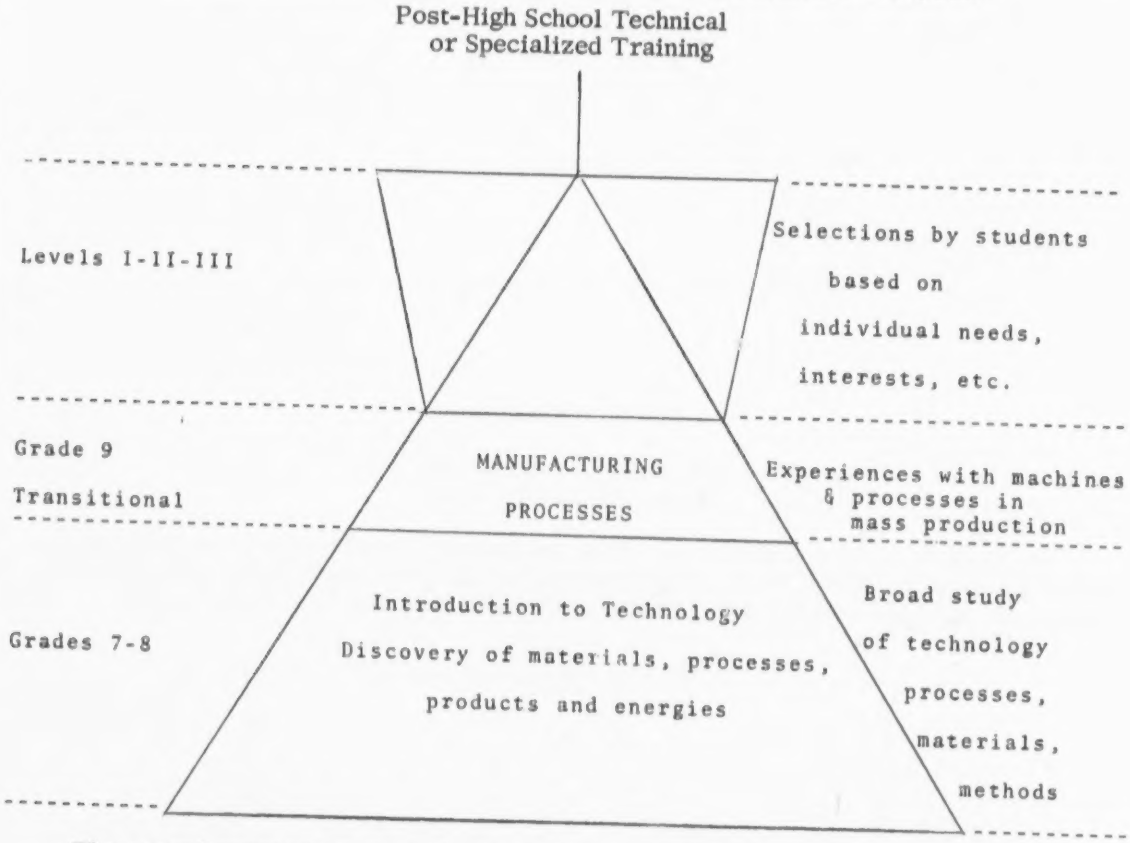
The circular model presented earlier could serve to illustrate this very adequately, with only the substitution of the traditional industrial arts areas for the bodies of knowledge.

A diagram is now presented to show the possible organization of an industrial arts program for the secondary school encompassing grades seven through twelve. The pyramid shape is used to illustrate the fact that course content is broad and comprehensive in grades seven and eight and narrows to possible specialization at the high school level.

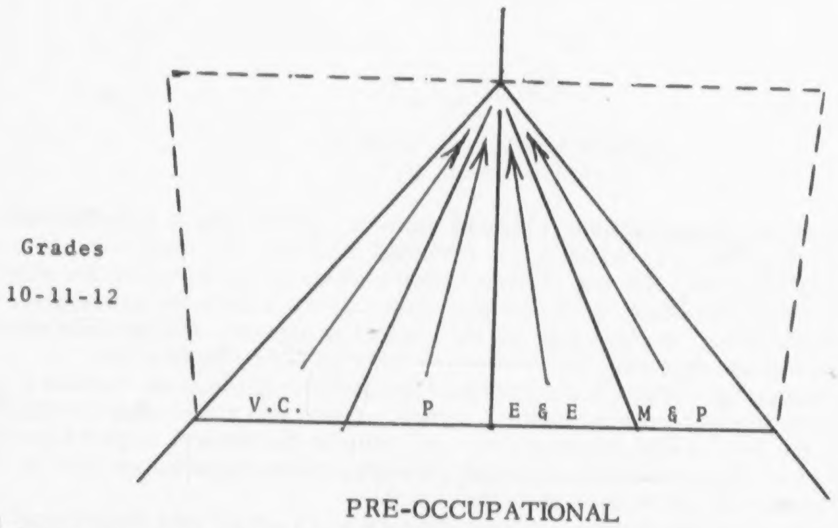
At the same time, it is recognized that specialization can be broadening as illustrated by the expanding portion of the model at the peak of the pyramid. The top segment of the pyramid (Levels I, II, III) would include the four broad areas presented earlier, that of visual communications, electricity/ electronics, power, and materials and processes.

The possible approaches to implementing these areas are threefold, with the first being pre-occupational. In this type of organization students interested in preparing themselves for a specific future occupation would work in only one of the industrial arts areas for their three years of high school. Their work would be considered pre-occupational and would be structured to give the best possible preparation for future employment.

ORGANIZATION FOR INDUSTRIAL ARTS - SECONDARY SCHOOLS

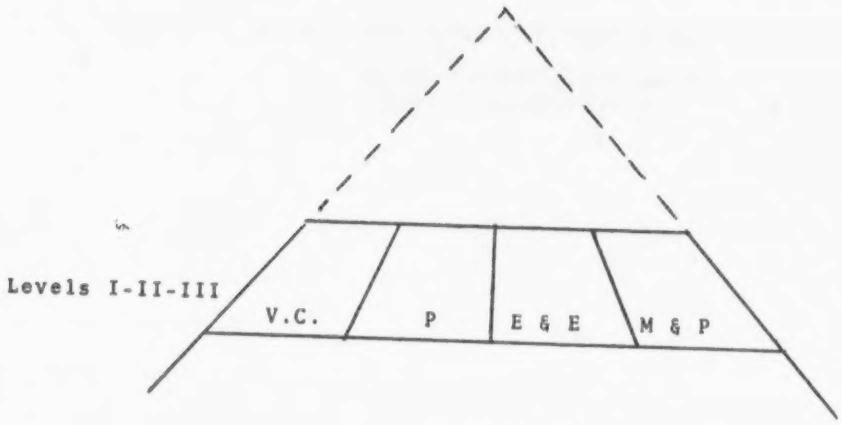

Post-High School Technical
or Specialized Training
Levels I-II-III
Selections by students based on individual needs, interests, etc.
Grade 9
Transitional
MANUFACTURING PROCESSES
Experiences with machines & processes in mass production
Grades 7-8
Introduction to Technology
Discovery of materials, processes, products and energies
Broad study of technology processes, materials, methods

The second approach is an exploratory program offered to give students a wide range of experiences at an introductory level. This would be designed for that majority of the students who need and desire to have a broad understanding of technology. As shown in the diagram, all industrial arts areas would be involved, and the student would select those of interest to him. He would not concentrate in any one area, but would gain a breadth of experience.


Grades
10-11-12
V.C.
P
E & E
M & P

PRE-OCCUPATIONAL

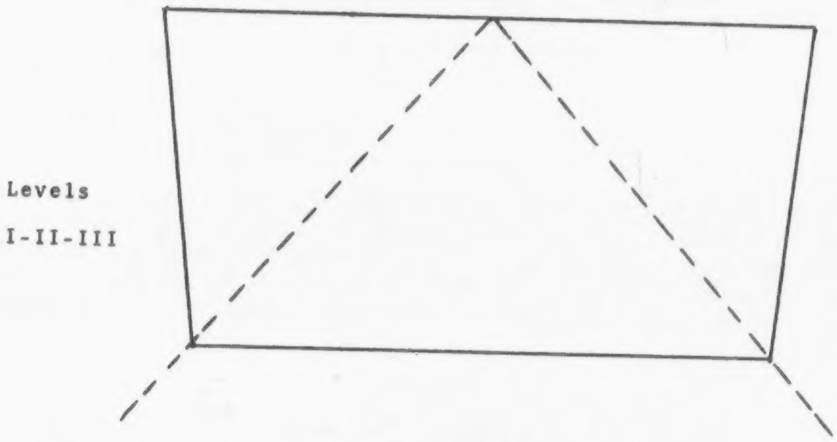
Specialized experiences for students intensely interested in a single area of study
or
Students unable to be self-directive



EXPLORATORY

wide range of experiences
at an introductory level

The third approach, and the one which we believe should hold a major interest for industrial arts, is that which is considerate of individual interests and needs. It is here that the learning can become broadening though the student may tend to specialize.



SELF-DIRECTED

unlimited movement to allow
student flexibility

A student is not bound to a particular area of study or lab but rather to the solution of a problem he has selected. The problem is developed from current interests and needs, a plan of attack is outlined, and the student then proceeds to work toward the solution. As he works, he will very likely find new interests that were unknown previously, thus broadening his experience. In this program the student is allowed, and possibly encouraged, to pursue new-found interests and to explore them as far as he desires.

Freedom of movement (within some practical limitations) through the various labs is encouraged, with the student working under a self-developed and self-imposed structure. Self-direction is the key to this organization, for it allows the student to gain knowledge and experience in many diversified areas of study through a class organization that is more realistic and reflective of our modern technical society.

It is here that the intradisciplinary efforts within the industrial arts department have importance. Freedom of movement throughout the entire department is needed, allowing the student access to all labs, to the equipment and to the teacher expertise contained therein.

From this presentation, two main ideas emerge:

(1) That the industrial arts curriculum, as a part of the technological body of knowledge, should evolve as an interdisciplinary approach with the other major disciplines of science, communications and human studies.

(2) That for optimum staff efficiency and student development, an intradisciplinary approach be developed among the areas of power, materials and processes, visual communications and electricity/electronics.

The limitations of time prevent any more than this short introduction to the many interdisciplinary and intradisciplinary possibilities for a modern industrial arts program. Though some work has been started in these areas, only the mere skeleton of an idea has been presented. More study, exploration and experimentation are needed.

Messrs. Bame and Lutz are on the faculty at Warrensville Heights (Ohio) High School.

Industriology for the elementary school

Duane A. Jackman

Industriology has been defined as the science of industry. The Industriology Project is a curriculum project aimed at broadening and up-dating industrial arts. The philosophy of industriology was based on the fact that all people were affected by industry as they participated in an industrial society. Technological advances have brought industry to the forefront in our society. People were involved as they became producers, consumers and purchasers. It therefore appeared desirable that all people should obtain an understanding of industry.

Industrial arts in the past has been quite narrow in scope at the secondary level. A United States Office of Education study by Schmitt and Pelley revealed this to be true. Dr. Rudiger of Stout conducted a similar study for the State of Wisconsin, which revealed much the same to be true.

The structure and content of industriology naturally centered around industry. Industry was defined as an institution in our society with the basic purpose of producing, servicing and/or distributing things of value for society. Something of value may be a physical object, or it may be a type of service related to physical objects. This connoted a much broader scope than woodwork and drawing, which have comprised too many secondary industrial arts programs.

Industry in our society has been involved in what might be referred to as the industrial economic cycle. It began with consumer demand and cycled through raw materials, manufacturing, distribution and service.

A two-pronged approach has been used in industriology as a basis for studying industry. The first prong was concerned with the types of industries and the second prong with the activities of industry.

The first prong was used to examine the four basic types of industry which were found in our industrial society: raw materials, manufacturing, distribution and service. The raw material industries were those industries involved with extracting raw materials from the original locations, such as the extraction of metal ore or petroleum, or food from the earth, and fish from the sea. The manufacturing industries were those concerned with producing a product - finished or partially finished - or processing a material. The distribution industries were those concerned with distributing finished products, unfinished products or materials to desired locations. Service industries were those which provided a service to a physical object produced in industry.

The study within an industry was pursued with the second prong of the approach. In most industries, six activities were likely to be found. The first activity was development and design, which could be depicted by a draftsman at work. Purchasing was the second activity found in most industries, which involved such things as writing specifications for items to be purchased. A third activity was that of manufacturing or processing, which involved both production planning and related activities, as well as the actual production or processing. Another activity found in industry was that of internal finance and office services. Among many jobs was that of an office girl performing the necessary and some very important office duties. Still another activity of industry was industrial relations which, among other employee services, was involved with training programs. The final activity of industry was that of marketing, which involved dispensing a product or service.

The two prongs, then, of the industriology program, upon which the content was based, were the four types of industries – (1) raw materials, (2) manufacturing, (3) distribution and (4) service — and the six activities of industry – (1) development and design, (2) purchasing, (3) manufacturing or processing, (4) internal finance and office services, (5) industrial relations and (6) marketing.

From this content an instructional program centered around six general objectives:

(1) Interpreting Industry - To develop an understanding of industry and its implications for modern society.

(2) Problem-Solving Ability - To develop the ability to solve industrially-related problems.

(3) Creativity and Design - To develop the ability to create, design and appreciate industrial products and methods.

(4) Skills - To develop a degree of skill and safe practices in the use of tools, machines, materials and processes of industry.

(5) Communications - To develop the ability to communicate using the language of industry.

(6) Practical Application - To develop the ability to apply other education in practical and industrially-related situations.

The instructional program in secondary schools was designed to be offered in four parts or phases:

Phase I - Development and Structure of Industry
Phase II - Basic Elements and Processes of Industry
Phase III - Modern Industries
Phase IV - Vocational and Occupational Guidance

Development and Structure of Industry, Phase I, a one-year course, was intended for 7th-, 8th- or 9th-grade students. It was designed to provide a general overview of industry for all students, girls as well as boys. It involved a general examination of the four types of industries and the six activities of industry. It was recommended that this course be required of all students.

Some instructional materials on industriology have been developed under the leadership of Jack Kirby:

(1) Four books for Phase I, Development and Structure of Industry -- Study Guide, Teaching Plan, Information and Job Sheets and Instructional Aids List -- are available at a nominal cost.

(2) Four sets of slides -- #1 The Industrial-Economic Cycle; #2 Activities of Industry; #3 Raw Materials-Metal Extraction; and #4 Manufacturing Industries-Tire Manufacturing -- are available on a free loan basis.

(3) Three video tapes, Tracer Lathe Operation, Assembly Line Assembly and Time and Motion Study, have been used by the cooperating schools in the industriology project.

In the future other materials will be developed, and announcements will be made when they are available.

Elementary industriology. Industriology in the elementary school is attempting to do the same thing as the program in the secondary school, i.e., to broaden and up-date industrial arts. Industriology will provide students with a better understanding of industry than is common in many industrial arts programs. Last summer we conducted a six-week industriology program for children who had completed either fourth or fifth grade. Some of the units studied were: The Development of Industry, Family Industries, Division of Labor, Mass Production, Raw Materials, Activities of Industry, Industrial-Economic Cycle, Transportation and Communications.

One mass production project we used was making Model T Fords. It involved cutting top and bottom body pieces, starting nails, applying glue, driving nails, setting nails, drilling holes in the body for fastening wheels, sanding the body, smoothing the wheels, painting the wheels and bodies and assembling the cars. Such things as planning, inspection, quality control and so forth, while omitted from the above list, were performed.

Field trips were a planned part of the work. Prior to the mass production unit, the class visited an industry to see a production line in action.

During the class a number of individual projects were made by the students, such as engraved plastic name plates and bases, laminated plastic pen bases, note stationery printed with linoleum blocks and rubber stamps, vacuum forming plastics, boats, trucks, rubber stamps and birdhouses.

Industriology has been integrated with other subjects in the elementary school program in many ways. A short time ago I was informed of the use of a plastics plastisol bait item. It was used to motivate some boys in remedial reading. The project provided a great stimulus for them in reading; they also learned about the life cycle of the frog, its organs and habits; and they learned about the plastics industry, one type of plastics material and one of the processes used in the plastics industry. By enriching the elementary school program with industriology, children are motivated to learn more in academic subjects as well as to learn about industry in a way they can understand.

Mr. Jackman is a member of the faculty at Wisconsin State University, Platteville Campus.

Exploring the application of technology in the solution of major societal problems

W. Harley Smith

The trends in curriculum thought seem somewhat revolutionary when compared to many current school practices. However, these trends appear to be supported by a well-founded rationale and may enjoy even more support as research is undertaken to substantiate their claimed merits. Because we subscribe to the trends of thought in curriculum, our proposal for a new role for industrial arts in the senior high school has characteristics and features that are consistent with these curriculum ideas. I would like to describe for you two instructional approaches which have been utilized in the study of major problems facing man in the years ahead, and which provide for the implementation of many emerging curriculum ideas. The first instructional approach I will discuss is the unit approach.

One of the characteristics of the unit approach is the unit organization of study. This involves a broad-area topic that is studied through a focus on its component sub-areas. Unit studies dealing with the application of technology in the solution of major social, environmental and operational problems that face man may be carried on under several possible unit topics. Our proposed unit topics are:

> Transportation needs and the future with implications for technology and human ingenuity.
>
> Pollution control and the future with implications for technology and human ingenuity.
>
> Conservation needs and the future with implications for technology and human ingenuity.
>
> Housing, structures and architecture and the future with implications for technology and human ingenuity.
>
> Communications and the future with implications for technology and human ingenuity.
>
> Power generation and the future with implications for technology and human ingenuity.
>
> Production processes and the future with implications for technology and human ingenuity.
>
> Natural resources and the future with implications for technology and human ingenuity.

In addition to being characterized by the unit organization of study, the unit approach is also characterized by the contract method, independent study, the problem method, the project method and the seminar method. These characteristics are derived through a variety of student activities which will be described.

Following an introduction by the teacher to the unit approach and its purposes, the class is challenged to identify some of the various problems of the future which have implications for technology. The problems that are identified will center around those designated in the eight proposed unit topics. The students become involved in discussing and campaigning which culminate in a democratic selection of one of the problem areas which the class most wants to study. (It is proposed that a class deal with only one unit topic at a time.) From the chosen unit topic the class must derive component sub-topics which are suitable for individual study. Deriving a list of sub-topic possibilities from which each student may select a sub-topic of interest to him requires the class to analyze critically the main problem that is identified in the unit topic. To exemplify what such an analysis might involve, let us suppose that a class has chosen the unit topic pertaining to pollution - "Pollution control and the future with implications for technology and human ingenuity".

To initiate the class analysis of the chosen problem, the teacher asks the class to identify sub-problems which are elements of the main problem. For the main problem of pollution, the students may identify water pollution, air pollution, soil pollution, noise pollution, thermal pollution, etc., as the sub-problems. The next task of the class is to enumerate causes of each sub-problem. The causes of water pollution may be enumerated as industrial waste, petroleum spillage, sewage discharge, etc. The causes of noise pollution might be enumerated as aircraft engines, automobiles, industrial enterprise, etc. Once causes of the sub-problems are enumerated, the students have reached the point where they can select a sub-topic of interest to them for independent pursuit. In selecting a sub-topic, the student "contracts" to investigate in depth a particular sub-problem which represents a part of the total unit. He then becomes involved in researching, planning, constructing and reporting.

Researching and planning. Once selections have been made, the students focus their attention on their individual sub-topics. In this stage of the study, one observes that the student is very eager to construct something that depicts the sub-topic he has chosen. He may desire to construct a model replica or a demonstration model of a technological approach to the sub-topic problem. He may want to construct a display depicting a variety of technological approaches to the sub-topic problem. Another alternative would be to construct a display depicting the nature and characteristics of the sub-topic problem. The student soon discovers that in order to decide on a project and to develop project plans, he needs to become more informed about the sub-topic problem and technological approaches to it. In researching his sub-topic, the student needs to make use of libraries, contemporary newspapers and magazines, scientific journals, industrial concerns, government agencies, scientific organizations and societies, public utilities, commission reports, etc., in order to gather data about the sub-topic problem and possible technological solutions.

Constructing. After the initial planning, the student uses the industrial arts laboratory to materialize his plans. The tools, materials and processes that he may utilize are limited only by the provisions of the laboratory. The student selects those tools and materials and develops those skills which are necessary to construct the project.

Reporting. As the research and construction activities proceed, student-centered seminars become a valuable element in the class unit study. Periodic seminar meetings, under the direction of a student chairman, provide excellent opportunities for students to exchange ideas, to seek help with research and construction problems, to assist one another, to challenge the work of others as well as to be challenged, to report research findings, to learn about each of the other class members' sub-topics, and to bring the sub-topics together as cohesive components of the total unit. These last two values of the seminar are realized through oral presentations by each student over the period of the unit study. One purpose of the report is to convey to the class what the student has learned about the implications of his sub-topic for society and technology. Also of significance is the conveyance of the technical, scientific and economic factors which are related to the sub-topic. The student also informs the class of the research procedures he has used; the informational sources he has used; the problems he has solved; and the tools, materials and equipment he has selected and utilized in the construction of his project.

While the unit approach represents an approach in which student activities are largely independent, the second instructional approach I would like to describe places more emphasis on the individual's involvement in the group. This approach is the group project approach.

The features of the group project include group organization, role playing, the contract

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method, independent study, problem method and the project method. All of the group project activities center around the class construction of a single large project. (As is true in the unit approach, only one of the eight problem areas should be included in a single group project study.) The result of the class construction activity may be a working demonstration model of a technological approach to a major problem. An example of such a project would be an electric-powered vehicle as a technological approach to the problem of air pollution. An alternative to this type of project would be an exhibit or display depicting a variety of technological approaches to a major problem. Project planning and construction involve the development of working drawings and sketches; the use of a variety of tools, machines and materials; mechanization, illumination and animation of components. Regardless of the project design and form, the potential for student involvement and individual growth is inherent. Let us now consider the areas of student involvement which provide for this personal growth.

As is true in the unit approach, the group project study begins with an introduction by the teacher in order to familiarize the students with the nature and purposes of the group project experience. Active student involvement begins as the class identifies some of the problems of the future which have implications for technology. Student presentations and discussions lead the class to a democratic selection of a major problem which will be the focus of the group project study. The students proceed to organize themselves as an industrial company in order to produce a product. Once the class as a whole has determined what problem area it desires its project to focus upon, responsibilities for the details of producing the project are delegated to the various members of the class. These details include designing the project, locating pertinent information, planning of work activities, scheduling of deadlines, procuring needed materials, meeting personnel and man-power needs, etc. In carrying out their responsibilities, the students make use of a project-oriented, limited-production, industry-management structure as they role-play functional management positions in the class company. Each student, in addition to having management responsibilities, is a worker in the company production department. It is in this capacity that he contributes to the construction of the group project.

As the various departments in the company begin to function, periodic staff meetings and special purpose meetings are held under the direction of an appropriate student department head. Staff meetings are led by the project director, meetings for safety instruction are led by the safety engineer, production planning meetings are led by the production director, etc. The purposes of such meetings are to facilitate management planning and operation, smoother production and a sharing of information.

One series of special meetings is coordinated by the director of education and training. His educational program provides an opportunity for students to compare their management role-playing functions and responsibilities to those of their industrial counterparts. It is through the educational program that the class becomes informed about the implications for society of the problem being studied. This program also brings the technical, scientific and economic factors related to both the studied problem and technological approaches to its solution. Films, guest speakers, field trips and student reports are all part of the educational program.

The group project approach, as well as the unit approach and the research and experimentation approach, provides opportunities for student involvement in a wide range of educational activities. It is our desire to re-emphasize what these provisions for a wide range of educational experiences suggest – that is, the program that has been presented here, in addition to exploring the application of technology in the solution of major social, environmental and operational problems that face mankind, has as a prime objective the building of people.

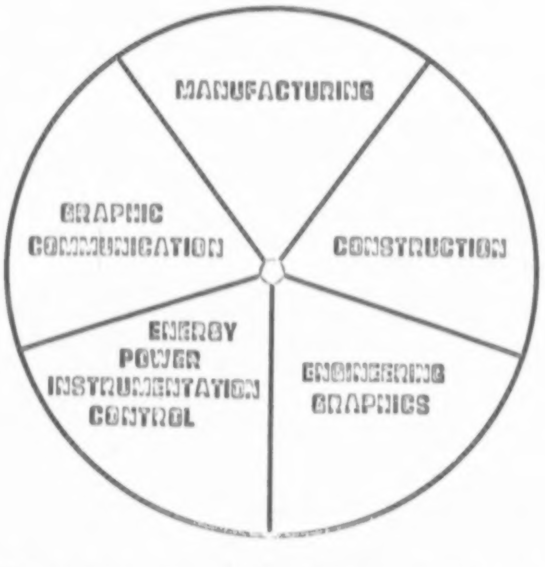
Mr. Smith teaches in the Prince George's County, Maryland, Public Schools

EPIC—an important segment of instruction in industrial arts

Anthcny J. Palumbo and David V. Gedeon

Why EPIC? Curriculum research has recognized and sub-divided industry into several elements selected worthy of exploratory study in industrial education. Areas so recognized, for example, are manufacturing, construction, communication, transportation and combinations of these, under various project headings. Although these elements are meaningful and are subject areas worthy of study, these elements alone do not clearly represent industry. One element is omitted – that part of industry we call energy, power, instrumentation and control – EPIC for short. It is important to note here that we are not saying that manufacturing, construction and the other elements are superseded or degraded by EPIC, but that these elements complement each other and together represent industry. Figure 1 illustrates the relative interrelationship of the elements of industry by equating industry to a pie; each slice contributing to each other, producing a whole. An example of this relationship exists when one looks to the manufacturing industry and notes how it uses energy, power, instrumentation and control to bring together materials and processes in order to produce finished goods. Further, we must not overlook the dependency of EPIC on manufacturing process for its very existence. In short, we are saying here that not only should an individual understand the processes and methods of manufacturing, construction, plus the other elements, but also the application of energy, power, instrumentation and control that make the processes and methods operate. Overall, then, we will develop an individual who really understands industry.

EPIC PROGRAM IN PERSPECTIVE WITH CORE PROGRAM IN INDUSTRIAL EDUCATION AT BOWLING GREEN



The challenge. The content area entitled Energy, Power, Instrumentation and Control has grown from the power technology area and has brought with it a total structure to represent the technology of today and the technology of tomorrow. Just as industry changes to keep abreast with technology, so must industrial education change its programs to keep abreast of the changes of industry. Today, we are in the phase of industrial expansion in which there is a continuing quest for machinery to supplement man's skills, energies and even his thinking abilities. Automation and cybernetics are elements in society which need to be studied. Automation is the use of mechanical, electrical and fluid devices, replacing human workers to regulate and control the operations of machines. Automation is not a new machine but a technology applicable to practically all, if not all, types of industries. *Cybernetics* is the science of devising control systems for machines which would closely approximate the processes of the human brain. The computer is a product of cybernetics. Automation and cybernetics rely on mechanic, electronic and fluidic devices for performing the human brain functions and use mechanical, electrical, fluid or combinations of powers to guide the tools and/or operations. Thus, there exists a marriage of technical fields in order to accomplish these high demands for productivity. To understand automation and cybernetics, it is essential that interrelationships of the technical fields be studied in unison. We who claim to study industry and the systems that make industry move must develop programs to give students the necessary interrelationships.

The EPIC approach. As part of the total program in industrial education, EPIC, as the title suggests, directs itself to the interrelationship of energy, its conversion into useful power, and the necessary instrumentation and control devices needed to harness power, to do the variety of tasks necessary to maintain and advance our society. The EPIC approach is not an automotive or power mechanics course, a fluid power course, an electricity/electronics course or a computer course. We are not suggesting here that these courses are not important to study in industrial education, but rather that EPIC provides the necessary concepts that will better enable students to select specialties and understand the applications of automation and cybernetics in industry. Although EPIC draws its content from these and other courses, the EPIC approach eliminates barriers which previously existed between these areas and has brought them together into a meaningful whole. To accomplish this, the content of single courses was analyzed to determine common denominators operating in each field, resulting in a final conceptual framework from which the EPIC program evolved. Figure 2 illustrates this concept framework, upon which the EPIC course is developed. Instruction, evaluation and laboratory experience in the EPIC program stresses and implements this structure. The concept structure, although general, gives an overall view of automation and cybernetics. Once this overall view is established, each of the major concepts can be further sub-divided to present a taxonomy which moves from concept to reality. By mastery of these concepts, a person can analyze, diagnose and understand any automated or cybernated system.

To give direction for student activities and evaluation, various general objectives can be derived from the concept and taxonomy structure and necessary EPIC application skills. The following list is typical of the general objectives for which the EPIC program lends itself:

(1) To develop within each student an understanding of automation and cybernetics and their importance to technological advancement.

(2) To develop within each student an understanding of the operational and scientific concepts of energy, power, instrumentation and control.

(3) To develop a degree of skill in applying the research and experimental approach to solving problems associated with automation and cybernetics.

(4) To develop a degree of skill in procuring, recording and reporting experimental data.

(5) To develop a degree of skill in applying the research and developmental approach to solving problems and meeting man's needs through applying automation and cybernetic concepts.

(6) To develop skills in applying the processes of analysis and diagnosis.

(7) To establish a basic understanding of EPIC systems which can serve as a base for advanced study of EPIC applications.

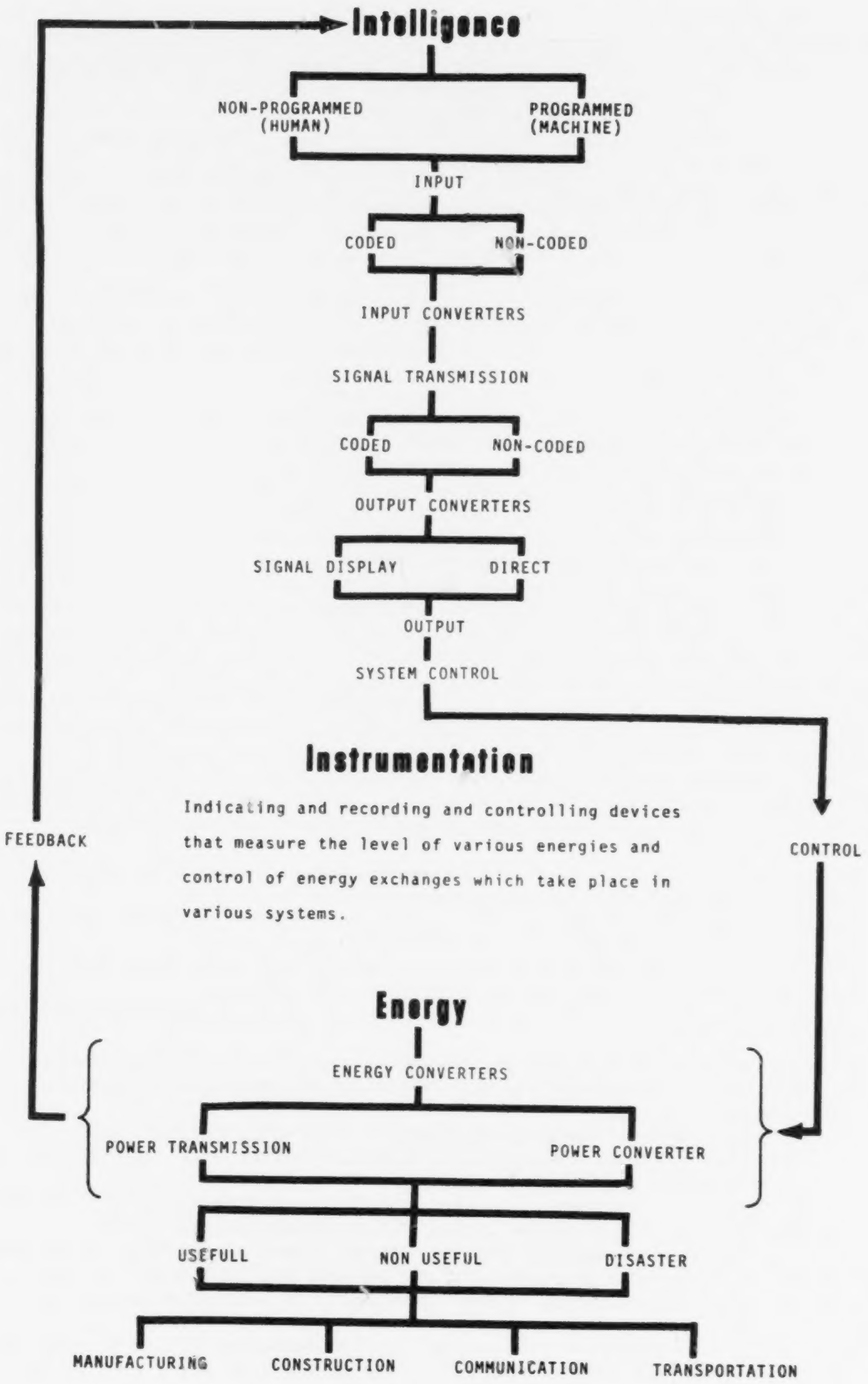
(8) To establish a relationship between energy, power, instrumentation and control and other industrial technologies dealing with materials and processes.

(9) To establish a relationship between energy, power, instrumentation and control and its use in domestic, entertainment, agricultural and medical applications.

(10) To allow the student to explore applications of automation and cybernetics in areas in which he expresses interest.

(11) To allow the student to role-play occupations associated with EPIC applications.

Hands-on in the laboratory. Although at first glance EPIC might seem to represent a theoretical, non-laboratory course, the use of the "hands-on" activity in the lab is essential for the operation of the program. Laboratory experience in the EPIC program is divided into laboratory concept discovery and laboratory/practical application experience, each contributing uniquely to student development.


Intelligence
NON-PROGRAMMED (HUMAN)
PROGRAMMED (MACHINE)
INPUT
CODED
NON-CODED
INPUT CONVERTERS
SIGNAL TRANSMISSION
CODED
NON-CODED
OUTPUT CONVERTERS
SIGNAL DISPLAY
DIRECT
OUTPUT
SYSTEM CONTROL
Instrumentation
FEEDBACK
CONTROL
Energy
ENERGY CONVERTERS
POWER TRANSMISSION
POWER CONVERTER
USEFULL
NON USEFUL
DISASTER
MANUFACTURING
CONSTRUCTION
COMMUNICATION
TRANSPORTATION

Indicating and recording and controlling devices that measure the level of various energies and control of energy exchanges which take place in various systems.

FIGURE 2

The laboratory concept discovery experience is a research and experimentation device which structures student activities along the concept lines. Several sheets are presented which give the students the necessary basic skills and experiences with energy, energy converters, mechanical, electrical and fluid power systems, and electronic, fluidic and mechanic control systems, plus associated instrumentation for measurement. Further, the experiments are so designed to teach the student how to organize and conduct experimental research, which is essential in many industrial job positions, as well as to present a logical method of attacking problems associated with diagnostic and analysis work.

The laboratory/practical application experience is a research and development scheme which allows the student to apply his mastered concepts to solve problems, thus giving him a chance independently to explore areas of interest. These experiences, depending on the level and interest of the particular individual, can result in a survey of EPIC applications in manufacturing, construction, transportation and communication or in-depth concept-linking, resulting in the development of new and different EPIC applications and/or modifications. Ultimately, the R and D activity results in the writing of an EPIC report (technical report) which is used to help guide the student during his practical application experience as well as to present a method used in industry to communicate research. Similarly, a copy of the student's technical report is held in a general technical file for use by other persons needing research information for their practical application experience.

In short, it is important to note that the laboratory activity follows the concept pattern and is designed to allow the student to explore the EPIC-related areas of his choosing.

Other activities. Along with the formal lecture and hands-on activities, the EPIC concept application approach lends itself to other learning situations. Brainstorming, industrial consultation and self-instruction become useful tools for increasing student learning and economically use the time available for EPIC study.

Brainstorming is a method whereby students direct themselves to solving problems via small-group discussions. This procedure is used in industry and is used by EPIC students to air out ideas, resolve problems and benefit from each other's comments.

Industrial consultation is utilized when the need arises for special help from people in the field. Students interview and "brainstorm" with experts concerning problems, select and purchase materials used in research, and in some university research write specifications for automation and cybernation applications to be used by industry.

In a program such as this, where conceivably everyone can be doing everything differently, it is important that the student get the routine skill instruction as well as application information as he needs it. To accomplish this the self-instruction technique is used extensively. Instructional materials and audio-visual equipment are combined in a convenient "push button" package, manuals, books and pamphlets made available through the student-kept "Technical File". Although self-instruction is utilized, the small-group demonstration is used when applicable.

Because EPIC is a conceptual approach, it can utilize the above activities as well as the hands-on experience to make the course a student-centered rather than a traditional instructor-centered experience.

The instructor's role. Contrary to what it might seem, the instructor's role is not eliminated by the EPIC approach, but rather re-emphasized. Because of the dynamics of the program, the instructor becomes a guide rather than an expert. The EPIC approach charges the instructor with more cognitive-developing rather than psychomotor-developing duties. (Cognitive duties deal with the thinking process rather than with the manipulative process.) We are not advocating that psychomotor skills be eliminated, but rather put into proper perspective with respect to any education program worth its salt. The instructor's roles are threefold and can be described as follows:

In the role of the concept innovator, the instructor makes sure that his instruction instills the necessary concepts that will give the students the necessary background for investigation.

In his role as idea stimulator, the instructor must provoke the student into using his own (the student's) ideas in solving problems. The instructor must refrain from using the "do as I do" technique.

Finally, as a constructive critic, the instructor must maintain a balance between frustration and effortless success so that the student is challenged by his experience.

As a whole, the EPIC instructor uses his conceptual knowledge to innovate, stimulate and criticize the type of educational activity that is interesting and relevant, to excite all students. The EPIC approach challenges the instructor and students; the challenge which ultimately results in students who can think for themselves and have the knowhow to solve EPIC-related problems.

Where do we go from here? EPIC is not a terminal industrial education program, but rather a beginning point for a long line of EPIC-related, in-depth study courses that can be taken by the student as he develops interest. It is important to note, however, that the student makes the decision based upon his experiences in EPIC and in other core-related fields. In this way the student will have less difficulty mastering the specifics in an application-related field because he has already been self-motivated. Further, he has mastered the basic concepts; thus only a brief orientation is necessary for specialized courses, giving greater allotted time for in-depth study.

On the other hand, for the student who does not desire any further study in the EPIC field, mastered skills and concepts can help him in his future occupation, even if he enters the areas of business and/or management. In short, we are saying that the type of thinking that evolves from practical problem-solving is applicable to solving many problems in life.

As technology changes, the demand for jobs and the products of industry will also change. The individual with the conceptual background as proposed in EPIC will be more flexible when confronted with technological changes.

Messrs. Palumbo and Gedeon are members of the faculty at Bowling Green (Ohio) State University.

EIA support to industrial education

C. J. Borlaug

The Electronic Industries Association (EIA) is a national trade association representing over three hundred US manufacturers of electronic products, accessories and components. These companies represent over eighty-five percent of the electronics manufacturing output of the United States.

The Consumer Products Division of EIA consists of US manufacturers of radio and television receivers, phonographs and magnetic tape equipment. For many years these companies have been actively concerned with providing dependable service for their products.

The Service Committee of EIA is one of the oldest of EIA's standing committees. Among the members of this committee are the national service managers of the companies in the Consumer Products Division.

For over fifteen years the EIA Service Committee has sponsored texts, laboratory manuals and other teaching aids for use by schools. These materials are presently considered to be the most timely and useful publications available in the area. Since their original release, these publications have been accepted by schools to an extent of around a million copies. The EIA-sponsored laboratory manuals alone are currently being used at a rate of well over 100,000 copies per year.

The experience and background of the Electronic Industries Association makes it well fitted to offer guidance and recommendations for an educational program in electronics to fulfill the needs for well-trained personnel in this fast-growing industry.

Working with educators and writers, EIA has developed a number of highly successful technical and lab manuals and their corresponding instructor's guides.

Faced with requirements for increasing numbers of technicians for an expanding electronics-radio-television industry, as well as with a rapidly-expanding technology, the Service Committee of the Electronic Industries Association (EIA), in association with Voorhees Technical Institute (VTI), has long been active in developing and constantly revising educational materials to meet these challenges. In recent years, the pressing need for instructional materials designed to serve students of various backgrounds and abilities has also become evident. These new conditions, coupled with an increasingly critical shortage of trained technicians, have induced EIA to sponsor the preparation of a wide range of materials, tailored to meet a variety of requirements.

The Basic Electricity-Electronics Series. This series includes: "Electricity-Electronics Fundamentals", "Basic Electricity", "Basic Electronics" and "Instructor's Guide – Basic Electricity and Electronics". These laboratory text-manuals provide in-depth, detailed, completely modern technical materials, combining a closely coordinated program of experiments, each preceded by a comprehensive discussion of the objectives, theory and underlying principles. "Electricity-Electronics Fundamentals" provides an introductory course especially suitable for industrial arts courses or preparation for service technician training, while "Basic Electricity" and "Basic Electronics" are planned as 270-hour courses, one to follow the other, providing a more thorough background for all levels of technician training.

The Radio-Television Servicing Series. This series includes materials in three categories – those designed to prepare apprentice technicians for performing in-home servicing and apprenticeship functions; those designed to prepare technicians for performing more sophisticated and complicated servicing, such as bench-type servicing in the shop; and those providing advanced servicing techniques training.

The "in-home"-apprenticeship servicing courses include "TV Service Training – An Entry Into TV Servicing" and "Television Servicing Diagnosis". "TV Service Training" is a profusely illustrated text, lab workbook and instructor's guide designed to train persons with no previous electronics training with job-entry trouble-shooting skills for servicing in the home. The text utilizes the cue-response concept of diagnosis, concentrates on identifying abnormal circuit operation and symptom analysis, and develops skills in troubleshooting. "Television Servicing Diagnosis" consists of a series of color-sound motion picture film loops, plus a student response workbook and an instructor's guide. These audio-visual materials function as an integrated learning system to teach color-TV adjustment and set-up procedures, plus trouble symptom diagnosis and the ability to isolate troubles to a given stage in the receiver, concentrating on the requirements for servicing in the customer's home. But these audio-visual materials can also be used to supplement all levels of television courses. This medium is especially suitable for those in the student population who may have reading and, in turn, learning difficulties. Since only a minimum of electronics theory is presented in both these courses, it is expected that apprentices completing these programs will be motivated to progress to the more comprehensive programs provided by the other courses in this series, in order to deepen their understanding of electronics and of what makes the television receiver work and to obtain adequate proficiency for the servicing of all consumer electronics entertainment items. Our schedule calls for this material to be available in September of 1970.

The "bench-type" service technician courses consist of: "Basic Radio: Theory and Servicing" and "Basic Television: Theory and Servicing". These books provide a series of experiments, with preparatory theory, designed to provide the in-depth, detailed training necessary to produce skilled radio-television service technicians for both home and bench servicing of all types of radio and television. A related instructor's guide for these books is also available.

The advanced servicing series includes four books: "Advanced Servicing Techniques - Vols. 1 and 2", a related "Laboratory Manual" and an "Instructor's Guide". The advanced series may be used to build on the technical background the student has gained from study of the bench-servicing materials, and also to provide refresher courses for practicing service technicians. Volume 1 and the lab manual cover advanced servicing techniques for color and black-and-white television of all types, while Volume 2 provides servicing techniques for FM and FM multiplex, stereo amplifiers, record changers, tape recorders, home intercoms and combination receivers.

The Industrial Electronics Series. Basic circuits and courses in industrial control laboratory standard measuring equipment are provided in "Industrial Electronics", "Electronic Instruments and Measurement" and their related instructor's guides. "Industrial Electronics" is concerned with the fundamental building blocks in industrial electronics technology, giving the student an understanding of the basic circuits and their applications. "Electronic Instruments and Measurements" fills the need for basic training in the complex field of industrial instrumentation. Prerequisites for both courses are "Basic Electricity" and "Basic Electronics".

The foreword to the first edition of the EIA-VTI Basic Series said: "The aim of this basic instructional series is to supply schools with a well-integrated, standardized training program, fashioned to produce a technician tailored to industry's needs." This statement is still the objective of the varied training program that has been developed through joint industry-educator-publisher cooperation.

The Service Technician Development Program is an expansion of EIA's efforts to provide meaningful assistance to schools wishing to offer up-to-date service technician training.

Consumer product sales and levels of sophistication are expanding at such a rapid rate that it is believed that the field could absorb 30,000 new service technicians now. Moreover, with the growth of present products and the advent of new ones, experts anticipate the development of opportunities for many more new service technicians each year.

The Service Technician Development Program has objectives in five main areas. These areas are: (1) Career guidance; (2) Encouragement of schools wishing to establish new service technician training programs; (3) Assistance to schools with established training programs; (4) Technical assistance to in-service teachers; and (5) General service industry development.

(1) Career Guidance activities include a 16 mm color film depicting the advantages of a career in electronic servicing and guidance brochures. The film has been distributed through normal educational film channels and is free to schools. The guidance brochures are suitable for use with youths and adults respectively.

The career film, "The Electronic Service Technician - Futures Unlimited," was produced and put into distribution in September, 1968. Response to the 16 mm color and sound film has surpassed initial expectations. Originally 90 prints were placed in general distribution, and 10 prints were set aside for TV station distribution. Demand has been excellent and recently, when the waiting period began to extend past three months, the Division authorized making 100 more prints to be distributed. There are now 140 prints in general circulation and 10 in TV station circulation.

Through February, 1970, the film has had 97 showings on television to an estimated two million people. In addition, there have been a large number of requests for TV station previews which will later result in additional shows.

Also, through February, 1970, there have been 2,205 showings of the film to general audiences with an estimated 197,701 viewers. In analyzing these bookings, it was found that slightly over 80 percent were high schools, 9 percent colleges and universities, 4.6 percent professional organizations, 2.4 percent industrial groups, 1.6 percent educational groups, and only 2.4 percent in the miscellaneous categories.

With 90 percent of the bookings in the school classification, it can be assumed that we are reaching our intended audience, the 10th-grade high school student, and that we are successful in reaching them in numbers.

Any success in attracting additional young men into the service technician field will aggravate an already-existing shortage of good service technician training programs in the industrial arts and vocational schools. Under the STDP program, 15,000 "Here's Something You Can do to Help Solve the Service Technician Shortage" booklets have been printed. This booklet describes steps that local individuals, companies or groups can take to interest local schools to set up or increase their technician training programs.

Ancillary material has been developed to go with, and is described in, the booklets (i.e., lists of laboratory equipment and average school prices, a lab floor plan, etc.). Present plans call for enlisting NEA, NATESTA and EIA's Service Committee's help in promoting this program.

(2) Encouragement of schools wishing to establish a new technician training program is accomplished through the medium of program development guidance.

EIA can offer help in many areas, such as sources of financial assistance, industrial advisory committees, student recruitment, physical plant requirements, equipment and supplies, curriculum, industry relations, cooperative programs, teacher qualifications, student placement and so forth. Implementation of the type of program outlined in the guide can be assisted through the use of an educational advisory service when necessary.

(3) Assistance to schools with an established training program can be provided in a variety of ways. The principle problem associated with existing training programs is basically one of timing. Many years may elapse between the time that industry introduces a new technique, process or product and the time when it becomes an integral part of school curricula. This lag in timing can be greatly shortened if new industrial developments can be translated into a form usable in schools. The Service Technician Development Program will provide this service in the form of an educational newsletter for technical teachers. The effectiveness of this newsletter can be reinforced by use of the educational advisory service where appropriate.

(4) Technical assistance to in-service teachers can be provided in part by the educational newsletter. However, the main effort in this area will be in the form of a national system of teacher training workshops. These workshops are conducted during the summer on a regional basis. The intent of the workshops will be to provide teachers with a well-rounded view of current consumer product technology.

(5) General service industry development will be achieved through a public relations effort aimed at informing the public of the important contribution to our society being made by the electronic service industry. This effort will benefit schools by making both prospective students and their parents more receptive to the idea of a career in consumer products servicing.

The Service Technician Development Program, combined with the EIA Service Committee-sponsored publications, forms the oldest and most comprehensive industry program of assistance to schools.

Mr. Borlaug is national service manager for the Sylvania Home and Commercial Electric Corporation.

Consumer electronic products—the state of the art

Ray J. Yeranko

On this, the fiftieth anniversary of radio broadcasting, it seems appropriate to recall some of the more significant events in the home entertainment area of the electronics industry before discussing the state of the art as it exists today.

Back in 1920, when consumer electronics products were limited to radios and amplified phonographs, sales of about 200,000 units having a value of 10 million dollars were recorded. From this humble beginning, which featured storage battery-powered radios with their goose-neck horn speakers, crystal sets and headphones, sales of radios and phonographs jumped to 200 million dollars in 1940, to 2 billion dollars in 1960; and sales of consumer electronic products valued at 5 billion dollars are estimated for 1970.

Significant milestones in the development and marketing of new products were achieved when television was introduced in the late forties, skyrocketing industry sales to 1-1/2 billion dollars in 1950. Stereo phonographs made their appearance in the mid-fifties and, after quite a number of unsuccessful attempts to take the television sales spotlight, color TV finally came on strong during the sixties and, in 1969, surpassed monochrome TV sales for the first time.

Let's review some of the more common consumer electronic products that grace our homes today:

Large-screen color television receivers that offer such features as instant-on sound and pictures; automatic tint circuits that keep people looking like people without fiddling with controls as channels and programs are changed; wireless remote controls that allow the selection of all 82 TV channels, control of color and volume, and turns the set on and off from the comfort of your easy chair; automatic fine tuning. One TV set will actually turn off automatically two minutes after the station signs off the air should the viewer fall asleep while watching the late show.

Also, solid-state stereophonic radio-phonograph combinations with AM and stereo FM radios; automatic frequency control for drift-free FM reception; stereo FM indicator lights or meters; bass-compensated loudness control; high-powered amplifiers; exponential high frequency horns; sealed air suspension speaker systems. We also offer . . .

Stereophonic solid-state tape recorders and players in a variety of models that will play either reel-to-reel, cassette or cartridge sound tape. Then there are the popular . . .

Portable solid-state TV sets that operate in your home, your car, or boat or on the beach. Also. . . .

Portable battery-operated solid-state radios and phonographs that operate anywhere. And if you're building a new home or remodeling an older one, you can buy a . . . .

Built-in intercom providing room-to-room communication plus radio and phonograph programming throughout the home.

These and other electronic products for the home are fitted with zenar diodes, germanium and silicon transistors, miniaturized integrated circuits, plug-in circuit modules, ad infinitum.

Considering the fact that new consumer electronic products are being introduced at an ever-increasing pace, it is not unreasonable to expect that this situation will continue. Looking back, we find that there was a span of about fifty-six years between the discovery that electricity created a magnetic field and the introduction of the telephone. The vacuum tube was under development for about thirty-three years. Radio development required fifteen years and television about eleven years. Moving closer to current times, the transistor, which is the heart of modern solid-state technology, was only three years in development.

What new products will be commonplace in the near future? Video-tape recorders and players, closed-circuit color TV cameras and systems, electronic ovens and electrostatic clothes washers are just a few of the products that will soon be available and priced within the reach of most Americans.

Laser beams and micro-miniature thick-film and thin-film circuits, which are growing in popularity with military and industrial users, will find their way into consumer products soon, opening new areas of product services and features.

With all the technological advances that have been made to provide not only new features but also greater reliability in our products, they still require some maintenance. More men qualified to deal with the repair of the sophisticated, complex circuitry in these products are needed to fill an existing vacuum and to keep pace with the increasing numbers of such goods reaching American consumers' homes daily. A noted business executive has said, and I quote, "Never before have so many products of such high quality been available to so many people -- and probably never before have so many customers been dissatisfied with what they're getting." The reasons for this strange state of affairs are varied, but it boils down almost entirely to a lack of good service.

In addition to the many EIA-sponsored training materials available, it should be noted that all consumer electronic manufacturers conduct thousands of hours of service training annually to upgrade the technical expertise of the men who install and service their products. (Our company provided over 45 thousand man-hours of service training last year at 7-1/2-hour day schools held in 130 cities during the spring and in the fall of the year. Additionally, hundreds of men participated in lecture-workshop training seminars at seven strategically-located Magnavox Service Training Centers.) While these programs upgrade practicing technicians, they don't help much in attracting more men into the servicing industry. On Friday, April 10, we announced a new Color TV Service Home Study Course to our dealer organization. I believe it is unique to the extent that registration is limited to young men with no electronics experience and who are sponsored by a servicing dealer or an independent service agency. The sponsor must agree to permit the student to carry out his "laboratory" assignments in the sponsor's service shop, using his test equipment and TV chassis.

When the student completes his sixteen-lesson course and passes the last of the many quizzes given, he will have reached the level of an apprentice technician and will, hopefully, continue his training at a local school or at one of our training centers.

In summary, I have presented for your information, and, hopefully, for your edification, a word picture of the spectacular growth of our industry and of today's home entertainment products. They're big and beautiful and reliable, but they're also complex and need the attention of skilled technicians to service them from time to time. We seek your support in recruiting and training men to fill existing vacancies in a profession that offers unlimited opportunities. Will you give us a helping hand?

Mr. Yeranko is national service manager of The Magnavox Company.

Solid state servicing seminars

Joe Sloop

In speaking of solid state servicing seminars, I wish to call your attention to one conducted by Hank Wilchek at Bemidji, Minnesota, this past summer under the aegis of EIA. It was not necessary to be a service man in order to attend this conference and, as a result, many industrial arts teachers were present, along with undergraduates interested in solid state principles.

Course content consisted primarily of presentations made by representatives of companies in the business of manufacturing and servicing radio and television equipment, most of which utilizes solid state circuitry, and television receivers that could easily be bugged for common TV problems.

It was felt that the utilization of actual consumer-used products in a typical service course was not only practical, but added greatly to the motivation of those involved in the course.

Many more service courses of this nature are planned for the future. The housing facilities available at colleges lend themselves to such seminars, and it is hoped that teachers of electronics at the undergraduate level will initiate such with the assistance of EIA.

Mr. Sloop is on the faculty of Appalachian State University, Boone, North Carolina.

A proposal for an Electronics Education Council

Larry Heath

(This was taken from a tape recording of the discussion, and the effort here is to represent the major ideas that were presented. It is not a literal transcription of the discussion.)

This meeting is being held because of considerable discussion that has been going on for the past two years. Last year, at the Las Vegas meeting of the AIAA, several people expressed an interest in forming an electronics teachers' association that would function on a national basis. The people present at that discussion included: H. M. Wilchek, Associate Professor, College of Education, University of Hawaii; Dr. James L. Boone, Jr., Department of Industrial Education, Texas A & M University, College Station, Texas 77843; Dr. Ivin L. Holt, B 25 Brigham Young University, Provo, Utah; Richard White, Austin High School, Austin, Minnesota 55912; Dr. Fred Culpepper, Old Dominion University, Norfolk, Virginia 23508; Howard R. Schmidt, Bemidji State College, Bemidji, Minnesota 56601; A. O. Brown III, Kansas State College, Pittsburg, Kansas 66762; and Morris Tischler, Electronics Aids, Inc., 6101 Falls Road, Baltimore, Maryland.

The major issue that we wish to discuss is the formation of a national electronics teachers group.

Dick Rumrill, the editor for NETS, the National Electronics Teachers' Service, has described how NETS was formed:

The National Electronics Teachers' Service, headquartered at Murray State University, Murray, Kentucky, is a natural outgrowth of the NDEA Industrial Arts Institute in Electronics, held during the summer of 1968 on the MSU campus.

The inception of the idea for this association, of and for teachers of electronics, came about in a coffee break bull-session during the institute. The name came about almost automatically, with its initials spelling a word that has significance not only in electronics, but in the goal of a nationwide service as well. The need for NETS met with unanimous agreement among the 27 individuals most closely concerned with the NDEA Institute. These individuals contributed ideas for structuring the organization and formed the charter group of members. NETS is currently serving members in 28 states.

The fundamental goal of the organization is the improvement of electronics education on a national basis. It is the intent of NETS to implement this goal through service with teachers and other interested parties helping other teachers of electronics.

NETS acts as a clearinghouse/exchange service for free and "at cost" items such as teaching ideas, project plans, resource units, industry-contributed materials and sources of such materials and audio-visual aids.

Individuals or industrial groups wishing to participate in NETS may do so by contacting the National Electronics Teachers' Service, Murray State University, Murray, Kentucky 42071. The annual individual membership fee is two dollars. Members will receive monthly mailings from National Headquarters and the "NETS NEWS", monthly publication of the organization. Charter memberships will be accepted through December 31, 1970, the year for NETS.

The keystone of NETS is share – If you have a dollar and give it to me, you have no dollar. If you have an idea and give it to me, we both have an idea. Progress through participation.

As you can see, NETS is serving nationally as a communication line. The major issues that need to be discussed at this meeting are:

(1) Does this group desire to form a national electronics group?
(2) If it is desirable to form a group, how should it be done?
(3) If an association is to be formed, how can it be financed?

Issue I: After a brief discussion it was voted unanimously to form some type (to be discussed later) of electronics teachers' association. After considerable discussion, it was decided that:

(1) An interim steering committee would be formed to guide the establishment of a national association. The interim committee should consist of representatives from junior high, high school, junior colleges, universities and private schools with geographical representation across the United States. The work of the interim committee should be accomplished by mail.

(2) A time should be established for a meeting during the 1971 Miami Convention of AIAA.

(3) The NETS organization would be willing to print any notices or articles about the formation of the national association that would contribute to its development.

(4) Articles would be written and submitted to several electronics magazines and professional journals about the NETS effort and the interest in forming a national group of electronics teachers.

(5) No affiliation or formal structure would be sought at this time with any existing professional technical association.

(6) All electronics instructors, especially those present at the meeting in Louisville, would be urged to contribute with articles to NETS.

Issue 3: Finances. The present financial structure of NETS was discussed, and it was regarded as adequate for immediate needs. NETS has provided for industrial membership as well as for electronics teachers' memberships.

Summary: As a result of the two-hour discussion and subsequent small-group discussion the next day, it was established that there is definitely a strong interest in having a national electronics teachers' organization. Considerable conversation centered on exactly how such an organization should be structured and organized. The two major concerns seemed to be:

(1) That as many people as possible, in public and private education as well as in the industrial education and military education organizations, be involved.

(2) That any organization be kept simple and efficient. The major emphasis should be on helping the individual teachers do a better job of teaching.

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The development of a systems approach to teaching electricity /electronics

Alan R. Suess

The speakers making presentations at this session represent a rather diverse background. When the group first met, they came from Virginia, Ohio, Kentucky and Indiana. All four were professional teachers. One was a junior high school teacher, one a high school teacher, and two were industrial arts teacher educators. Each was involved in teaching electricity-electronics, and each was concerned about the problems of instruction in introductory electricity-electronics. All four had responded to an invitation to critique a proposed junior high school electricity-electronics program. Each person, without the knowledge of the other, was critical of the proposal and made remarkably similar recommendations for improvement. The result of the critiques stimulated the originator of the proposal to bring these people together in June, 1967, to discuss the possibility of forming a writing team to develop new instructional materials for introductory electricity-electronics. Tonight's presentations represent the fruition of that meeting of almost three years ago.

Each member of this group is an experienced electricity-electronics teacher. Each has experienced the frustration of watching beginning learners face failure and confusion. There are many factors that influence the difficulty of getting started in electricity-electronics. One dominant factor is the almost complete lack of background that a beginning student brings to the classroom. After all, electrical theory is based on behaviors that cannot yet be observed directly. This lack of a concrete "frame-of-reference" is particularly significant for junior high school students. Students of this age are in what Piaget describes as the transitional period of intellectual development between concrete operations and formal operations. Formal operations is the stage of learning that permits the learner to understand and form abstract concepts. The concrete operations stage still requires the introduction of new materials through concrete examples. Assuming Piaget is correct in his observations of how children and youth learn, a new approach to teaching electricity-electronics appears imperative. Instructional material in electricity-electronics is invariably developed by adults. Adults have well-developed formal reasoning ability. The result is usually a carefully-developed, logically-consistent presentation of the material. The four of us wanted a psychological, rather than a logical, approach, which involved the student and let him see examples of the effects of electricity.

Bruner, writing in The Process of Education, deals at great length with the problems involved in teaching new and abstract content to young learners. Bruner suggests that "...there is no reason to believe that any subject cannot be taught to any child at virtually any age in some form." The book contains several specific examples of how sophisticated content has been taught to children far younger than one would expect. The principal strategy used is to develop a "spiral curriculum". Such a curriculum introduces the basic ideas of the subject in a simple, concrete manner. These basic concepts are revisited repeatedly to review, reinforce and expand student knowledge of the material.

A spiral approach to organizing content was a primary goal of this team of authors. We wanted a book where broad concepts were introduced in simple terms that arouse curiosity in a student and yet provide enough information to be intellectually honest. Content introduced in such a way can be reviewed later in the course where new and more specific study of the broad concept places the material into a familiar context. For example, students can be introduced very early in a course to the idea that minor changes in the property of a material can alter its electrical properties. This is an important aspect in understanding semi-conductor doping. Doping is a rather advanced concept for beginning learners who are still trying to sort out the mysteries of electricity. The material is introduced to reinforce instruction about conductors and insulators. Later, when doping is introduced, the students quickly review the earlier content in the context of what occurs in the electrical properties of semi-conductors when impurities are added.

Several format considerations were also of common concern during our early developmental work. First, the typical basic textbook covered far too much content per lesson for the students fully to grasp the intricacies of the information. In addition, the lessons typically require a full period of lecture-discussion to cover the material. This means that the student has to wait anywhere from overnight to three or four days before he has time to confirm the theory through laboratory activity. Several factors make this learning situation undesirable. First, the attention span of young learners is not long enough to profit from all the content covered in the lesson. Second, the several-day lapse between presentation and confirmation can increase confusion, particularly if the student missed the content of the initial presentation. Educational researchers have known for more than thirty years that distributed practice is more effective than an equal amount of massed practice. A textbook with short, carefully-sequenced topics would make it possible for a teacher to present a five-minute "mini" presentation. This strategy allows time for laboratory confirmation of the material on the day it is presented.

Beginning students in a subject as complex and interrelated as electricity-electronics have a great deal of difficulty identifying the purpose of a given lesson. A common format that identifies the particular emphasis of each lesson and gives a broad overview of the lesson, coupled with a concise presentation of the theory, has great potential for facilitating efficient learning. In addition, a consistent format throughout the book continually enhances the learning of the student. As a result, the authors developed a common format for use whenever appropriate throughout each text.

Today's youth are concerned with the relevance of the material they are learning. This well-documented fact makes it imperative that the materials be developed which relate to everyday situations. These real-life situations have several attractive aspects. First, they make the content "real" and interesting. Secondly, these situations can serve to motivate the learner to understand the ways in which many of the everyday electronic and electrical devices operate.

State-of-the-art materials are also important in terms of relevance and motivation. One of the first decisions reached by this group was to include material that was important to devices in use. Solid state devices are now dominant circuit components. The fact that vacuum tubes occurred first in the history of electronics certainly does not constitute sufficient reason to teach them first. Vacuum tubes are unquestionably a vital part of electronics. They are not so important that transistors and integrated circuits should either be ignored or slighted. Most adolescents own transistor radios rather than vacuum tube radios. These same young people see advertisements for and want to purchase the tape recorders and record players with integrated circuits.

Modern schools are faced with the problem of presenting an ever-increasing amount of information to their students. The knowledge explosion is well-documented. The net effect of the new pressures on schools is to stimulate a search for more efficient methods of presenting the information. The authors were convinced that a solution would be to omit needless repetition. In electronics, for example, literally hundreds of circuits require an audio amplifier. Amplifiers wired from discrete components every time they are required merely force the student to repeat what he had done in the past. This lost time retards advancement to new knowledge. Properly-designed pre-wired modules, either integrated circuits or discrete component devices, can greatly reduce this unnecessary loss of time duplicating circuit functions that are necessary but not part of the content to be learned.

A limiting factor in many approaches to teaching electricity-electronics is the cost and complexity of the materials needed. Another problem has been that many software materials appear to have been written to meet the available hardware rather than the needs of the students. The authors favored an approach that fit the hardware to the needs of the software. In addition, the hardware should be low-cost standard equipment whenever possible. A limited number of parts obviously keeps the cost low. More important, it reduces the confusion and need for instruction in the use of the new components. Carefully-designed laboratory activities that use standard parts in simple and complex circuit experiments reinforce the knowledge about components, theory and circuits.

In summary, the basic premises used by this group were based on their experience in teaching and on their desire to develop relevant, motivational materials using today's content for today's youth. One of the guiding principles of the group has been to develop materials that increased the possibility of success and diminished the likelihood of failure. Every attempt has been made to take advantage of the most recent thinking in the psychology of learning. The task has been long and arduous, but thoroughly rewarding.

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Introduction to the development of a systems approach in electricity /electronics

James T. Ziegler

The theme of this convention, Man-Society-Technology, is very significant for the presentation at this session. In electronics we are working with future men who will create a society based upon technology. Just as technology is changing, so is education. Our schools are producing highly-intelligent students who expect intelligent treatment. This may sound good, but we all know that many of these students are reluctant and are changing many practices in education.

From this changing educational scene, two problems present themselves to electricity-electronics education.

Problem one--technology. Each tick of the clock brings new changes in technology. For education to be effective, the new technology must be taught. It is the now and the future. We have two choices--either teach everything that is new or become innovative in our teaching methods.

Problem two--tradition. Electricity-electronics education is unfortunately strapped to some educationally-unsound traditions. The present methods are based upon the experience of other technologies. These methods may be wrong for our unique body of knowledge.

Our dependence upon math is another tradition. Presently math is used as a substitute for a good explanation. The relationships that exist in electricity-electronics must be exposed for their full meaning. We need to show, explain and describe relationships. What is more important--to understand the relationships or to work problems mathematically?

In addition, our instruction has been traditionally with materials that do not reflect the current technology. Effective teaching requires the use of modern methods and materials.

Electronics is great because of the important role it has played in the progressive steps of our society. Although it is a modern tool, it has a rich and unique history. But let's not use this history to satisfy the social studies people or our early prophets; let's use it to show the development of a great technology.

Is the educational technology of our times reflected in our methods of instruction? Example one--in electronics we speak of programming. We know the characteristics of linear and branch programming. Yet, our materials are linear, never taking advantage of the benefits of branch learning. Example two--how many of us are still giving hour-long lectures to students who, according to educational research, have a twenty-minute attention span?

The problems created by technology and tradition call for a fresh solution, a change. Electricity-electronics is technology. Let it take its place as a justified leader. Let electricity-electronics education be a leader.

The key to the change can result from a very simple observation of learners. A young child walks over to a unit and turns a switch. Soon a picture appears. That child has operated a system, and television becomes a part of the vocabulary. At any age level our material items are perceived first as to category and then as to function. The identification and use come from this first impression. If three radios were placed before a group of students, they would first identify them as radios. They could be completely different in operation, but students recognize them as radios. The same process occurs with practically everything encountered. Have you ever heard these questions: What is it? What does it do?

The key to the use of a systems approach, then, is concepts, ideas and theories. These are of primary importance, because only through the use of concepts can we ever hope to keep abreast of the expanding electricity-electronics technology. The use of concepts, and their associated generalizations, eliminates the problems of the system method.

What are the problems? One, system characteristics. These are those unique features that are different from those of other systems. The use of concepts simplifies this complex problem. Two, system classification. What does the system do that is of benefit to us. And three, system identification, that is, those methods that further enable us to differentiate between systems. All of these problems are intertwined to form a confusing picture. Again, the use of concepts, and their associated generalizations, will simplify the scope of electronics and simplify the teaching of electronics.

We are advocates of this method. Who are we? We are teachers.

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The characteristics of an electricity / electronics teaching system

Dale R. Patrick

In order to exemplify some of the basic characteristics of the systems method of teaching electronics, I have decided first to point out some generalities about all electronic teaching systems and then to present a sample lesson from our system pointing out some of its unique characteristics. In this regard, then, I might say that the major characteristic of all systems is organization. Organization in a sense means such things as planned procedures, content selection, availability of materials and equipment, and a patterned sequence of events to follow.

Organization likewise provides a variety of personal services for the teacher to guide and assist him in making daily preparations. Such things as study guides, daily assignments, references, additional work ideas for advanced students, sample test questions and general preparational hints are some of the more common things that can be included under the heading of organization.

The system, then, with all its diverse organizational aids, makes this instructional approach extremely attractive for the inexperienced teacher. With it, for example, he can find a sense of direction and dimension almost immediately with a high level of success. For the more experienced teacher, however, the system likewise has a great deal to offer. In this regard I might say that it has the hardware for autonomy. For example, it provides a variety of materials and equipment that the teacher may build upon to meet the demands of any new or unique innovation that he may want to try. In a sense the system may be altered or followed at the discretion of the teacher according to his desires.

The characteristics that I have mentioned thus far in this discussion are very general and can be applied to nearly all teaching systems on the market today. The BEST system, for which the four of us have been preparing for the last three years, has some very unique characteristics that are not necessarily found in other systems. For example, our system has a low voltage power supply that is both an instructional device as well as a useful power source. Our system also uses the "mini-lecture" instead of the traditional hour-long lecture-demonstration sessions. The BEST system really teaches concepts instead of just giving lip service to them. This is done by using a spiral learning approach centered around the key concept of electricity dealing with sources, conductors, control, load and indicators.

The lesson discussed here is dealing with the concept of control and electronic devices that may achieve some form of control. An explanation of such things as transformers, rectifiers and filters is included in this presentation. In this lesson you must keep in mind that the presentation is only striving to develop a conceptual understanding of control. Three simple analogies are used in the experiment to demonstrate the function of these control devices. A simple telescope, a marble in a balloon, and two balloons and a hollow tube are the equipment needed for the lesson. The telescope shows how objects can be reduced or enlarged as correlation for the function of a transformer. The marble inside of an inflated balloon very readily demonstrates the action of a rectifier, while two balloons on the ends of a hollow tube show the principle of filtering. After the student has performed these three simple analogies, he then has a wealth of material as a base of understanding for further study of actual circuit components.

Now that you have a general idea of the lesson content involved, I will point out some things about lesson format. The lesson dealt with here, for example, is divided into five distinct sections. The first three parts of the lesson are considered as the text, while the last two parts provide the student with a laboratory activity. Part one of the text is called the introduction. *Its function is to tie this lesson* to other lessons for continuity and to point out generalities about the subject. This, in a sense, is used to open the door for the second part of the text, which is called the focus. Its purpose is to point out specific things that the student needs to know about the exploration section of the lesson. The third item is a question space, where the student may jot down things he would like to discuss about the text. These three sections are to be studied and used by the student prior to the class meeting.

The lab part of the lesson starts with a "mini-lecture discussion session" for the first ten minutes of the class period. At this time the instructor may discuss things mentioned in the text, answer student questions, or go over specific points that will assist the student's performance of the daily activity. The exploration or activities section is used by the student to perform the experimental part of the lesson. This may involve such things as measurements and data taking, sending out coded messages to a partner, constructing a stereo sound system or observing an oscilloscope waveform at key test points. At the conclusion of the experiment the deduction section is to be completed. It involves such things as answering questions, analyzing data and formulating key ideas about the lesson in general. This section is purposely designed to get the student to formulate his thinking about the lesson.

Several consecutive lessons are then combined into a common block of instructional material. The number of lessons in a block may vary from approximately five to fifteen class sessions. At the end of a specific instructional block, a summary lesson is inserted which does not have a lab activity. The instructor may use this time for such things as a short quiz, general review, an introduction to the next block of instruction or additional lab time to finish lessons. Several of these blocks are then tied together into a nine-week unit instructional package. Two nine-week units are formed into a semester package, with four units designed for a two-semester program. The entire eight units form a two-year program that has considerable depth and breadth for schools interested in a system of this duration.

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What the systems approach will do for you

William Edward Dugger, Jr.

Educational systems arose out of a knowledge input overload of teachers. In a recent article in The Washington Post, entitled, "Computer Software is New Frontier", the following data were listed:

> Of all the research and development work conducted by the human race since the dawn of history, about one half has been accomplished since 1950.
>
> Of all the scientists in the history of the world, about 70 percent are still alive.
>
> In 1960 a total of $13 billion in research and development generated 60 million

pages of technical reports requiring 55,000 journals in 60 languages for its total publication.

The rate of accumulation of scientific data is doubling every 8-1/2 years. And the indexing of this data is falling behind the rate of accumulation.

It has been estimated that 10 percent of all research is devoted to the search for information which actually is in existence but can't be easily located.

Not only has the teacher been confronted with the knowledge explosion, but also with an accelerated rate of social change in the world. We know how to compute the microamps in a semi-conductor emitter; however, our social system experiences continuing crime, pollution of our environment, decay of our moral fiber, and many other problems. The everyday teacher is confronted with growth of available material with which to teach.

The systems approach to teaching electricity and electronics can help the classroom teacher do a more effective job. A systems approach to teaching may be defined as a planned or designed organization of software, hardware and people for cooperative operation to complete a set of tasks for desired purposes.

Most educational systems are carefully-designed and -written sets of components, such as the textbook, the experiment manual and teacher's guide, that have been designed to prepare and initiate responses in the student. These written educational components are often referred to as the "software". Also, educational "hardware" should be researched, designed and produced to complement the software. The hardware is usually the experimental circuits, discrete components and the interconnecting leads. Also the hardware encompasses the measuring instruments used in the system.

The use of systems in education today has helped the classroom teacher to teach his students modern electronics technology more effectively. In using a prepared system, the teacher can be more of a director of the learning environment. Less time has to be spent in preparing stockroom components or homemade breadboards for individual experiments.

In the highly-structured system, each day in the course is planned and carefully thought out in every detail. A maximum of student interest should be sought by the designers of a systems approach. Opportunity should be made available for junior and senior high school students to experiment and to create projects and devices.

A comprehensive look at the electronic field should be taken by the students in an industrial arts electronics course. They should use third-generation learning materials designed around today's third generation electronics.

The ideal electricity/electronics system for teaching should develop analytical thought in the pupil. Unfortunately, most programs today cause the pupils to become data takers with little understanding of what they are doing. The authors of this program have sought to incorporate thought-provoking deductions at the conclusion of each lab experiment. Hopefully, these deductions let the student draw his own conclusions concerning the topic of the lesson.

The authors reviewed the most advanced and successful teaching concepts and techniques used in education today. Bruner's spiral curriculum was implemented in the development and design of the system. The first lesson, or the base of the spiral, represents generalizations fundamental to the subject. As the spiral decreases in size, the topics become more specific. At each level, previous information is presented in a new manner, so that it is a combination of review and new material.

The lessons should be written to help the student organize his own thought processes. At the end of each portion of text material, a space is provided for any questions the pupil may have to ask the instructor in the next class.

Since electricity and electronics are closely allied to physics, math and science, any systems approach should attempt to provide a transfer of learning to these disciplines. One prerequisite that the authors insisted on in the development of the system was to have the best-quality instruments at economical costs. Also, it was decided that a low-cost multimeter would be sufficient as the prime measuring instrument for the first year. The oscilloscope, we decided, was needed only in the last half of the second year of the course. All voltages used on the experiments are under 15 volts AC or DC to ensure safety on all experiments.

Many of the laboratory experiments can be built as projects by the avid electronics experimenter. A complete set of supplementary electronic projects is being investigated by the authors now, in the hope that they will be made available to the public at a later date.

The power supply designed by the authors is functional on all experiments. Also the power supply components double as the experimental components in the power supply experiment. The meters in the power supply (voltmeter and ammeter) are wired in such a manner that they are used not only to meter the power supply but also as basic meters for other non-power-supply experiments in the course.

In the system that the authors developed, the experiments were designed to be "open ended", to give the students the opportunity to arrive at more than one deduction. The lessons were designed to tell the pupil how to do something as well as why he should. The proper use of electronic instruments was designed into the system lessons, rather than assuming that the pupil, by some magical power, should know how to make electrical measurements.

The system was designed in 9-week increments so that school systems could expand the program after it was initially established.

The teacher should have a minimum of daily preparation, since he gives a "mini" lesson of 10-15 minutes. The Teacher's Guide should help the beginning teacher who has been assigned electricity and electronics straight out of college.

The systems approach in education is still in its infancy. Peter Drucker once postulated that education was an "organization of ignorance". Organization of our ignorance requires a systematic review of what must be learned, developed and tested if we are to understand, use and improve education.

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Electric motor dynamometer testing

Leigh Bernard Weiss

The importance of electric motors to a technological society is evidenced when one inspects consumer goods and industrial power requirements of today.

Problems may arise when the educator has to relate the concepts and theories of operation and develop understanding. It is advantageous to have not only software (test material, diagrams and charts) but also the hardware (motor, dynamometer and measuring instruments).

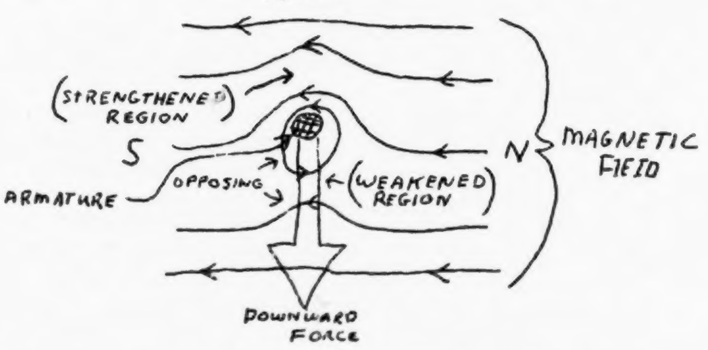
It is the purpose of this demonstration to acquaint you with some of the fundamental operational characteristics of motor testing.

General description. The electric motor, by definition, converts electric energy (potential energy) to rotary mechanical energy. There are, of course, subsequential losses due to friction - mechanical and electrical - which manifest themselves as heat. A motor which is connected to no load, but which is running, is doing no work other than moving its own rotor-mass through a circumferential distance. The load of a motor consists of counter torques that tend to oppose the rotation of the moving parts of the motor.

As the load on most motors varies, there tends to be a change of speed, and a corresponding change in the amount of work the motor is doing. An understanding of these changes is of particular importance and interest to the student.

DC motor. The direct current motor is comprised of three sections: the stator (field), the rotor (armature) and a commutator (rotary switch). (See Figure 1.) Attracting and repelling magnetic forces between the field and armature cause motion.

Figure 1



The speed of a DC motor can be changed by altering the field strength or varying the voltage applied to the armature, which is an electro magnet.

The windings of the armature coil, during rotation, cut the magnetic lines of force of the field magnets. As a result, there is induced in the armature a current which flows in the opposite direction from that which excited the armature (Lenz's Law). This reverse current is known as a counter electro-motive force, or Back EMF.

The Back EMF regulates the amount of current drawn by the motor. The faster the motor spins, the higher the Back EMF. Consequently, the DC motor is, to some extent, a self-regulating device. As load increases, and RPM drops, the Back EMF is reduced, effectively lowering the armature resistance. This lowered resistance permits greater torque, tending to overcome the load. (See Appendix A for an applied activity.)

AC motors vs. DC motors. AC motors offer a wide range of advantages over DC types, primarily in reliability, safety and availability of power. The most advantageous applications for DC motors are where large torques at low speeds are required, and great accuracy of speed control is desired.

Several types of AC motors are used commonly in consumer products and industrial applications.

The universal (series) motor is essentially a DC motor with a laminated armature core for reduction of hysteresis and eddy currents.

The induction motor (squirrel cage) is the simplest and most common type of AC motor. The principle of mutual induction in this system is exhibited. The stator is providing an alternating magnetic field, which induces a current in the rotor (of opposing magnetic flux), causing rotation.

Synchronous motors revolve at multiples of the applied voltage frequency. The armature of a large horsepower synchronous motor must be excited by a direct current source. An external source of power to bring the motor to operating speed must be provided. Small non-excited synchronous motors are used in turntables, clocks and other timing devices where constant speed is imperative.

Electric power. The DC motor consumes electric power in relation to the formula P = IE. (Power, in unit watts, equals the voltage, in unit volts, multiplied by current, in unit amps.)

The AC motor differs from the DC motor in that power consumption is effected by inductive reactance (frequency dependent) created by the alternating current power source.

Power consumption of AC motors can be equated by understanding the relationship of apparent power and true power. When calculating input power for an AC motor, measurements of the applied voltage and current are multiplied. Their product is the apparent power. However, in an inductive reactive circuit, as found in the AC motor, the phase angle existing between the voltage and current must be analyzed to equate the true power. The equation for this relationship is: True Power = E (voltage) x I (current) x cosine 0. This equation now introduces a new dimension to our calculations, that of power factor.

True power divided by apparent power equals the power factor. The power factor will be something between 1 (a purely resistive circuit with no Back EMF) and 0 (a purely inductive circuit with maximum Back EMF). In brief, power factor is the result of circuit reactance causing a current voltage phase shift.

The dynamometer. Mathematical calculation, with the aid of instrumentation, can yield total power consumption. Further investigation into motor performance is necessary if a student is to comprehend more fully the energy interchange from potential electrical energy to kinetic, rotary, mechanical.

With the aid of the dynamometer, the student can construct a torque and horsepower curve for the motor under study. The student can relate his findings to total input power, thereby deriving efficiency.

In the interest of a simplified explanation, the dynamometer can be thought of as a three-sections device. The first is the load cell. Its primary function is to apply a variable load (counter torque) to the output shaft of the motor. The load may be in the form of a friction brake, DC generator, hydraulic pump or an eddy current break, to mention a few. The absorbed energy is dissipated as heat either directly into the atmosphere or through a heat exchanger. In the case of the electric dynamometer, resistive loads convert the energy directly to heat, which is then dissipated. The second, the measurement section, analyzes the performance of the test motor. The revolutions per minute and torque are the two main determinations.

Rotary power can be equated as circular distance divided by time:

$$\frac{\text{Distance}}{\text{Time}} \quad \frac{2\pi R \times \text{RPM}}{60} = R \times \frac{2\pi}{60} \times \text{RPM}$$

$$\text{Therefore, Power} = \underbrace{\text{Force} \times R}_{\text{Torque (lbs.-ft.)}} \times \text{RPM} \times \frac{2\pi}{60}$$

$$\text{Horsepower} = \frac{\text{Force} \times \text{Distance}}{\text{Time}}$$

$$\text{Power} = \frac{\text{Torque} \times \text{RPM} \times 2\pi}{60}$$

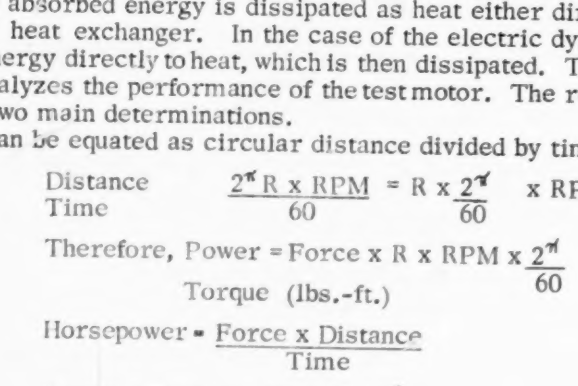
(746 watts = 1 horsepower)

(1, p.4,5)

The last section of any dynamometer system should contain measurement instruments for evaluating input energy consumed by the motor. This input energy can be compared to the output to equate efficiency. The electric motor dynamometer system requires three operational parameters to be measured for accurate input power calculation; input voltage, input current, and the use of a dynamometer watt meter or power factor meter.

The electrodynamometer watt meter will simplify the students' calculations. (See Figure 2.)

Figure 2



This instrument will directly read the power consumption of the motor. Briefly described, it is a combination of high-resistance voltage coil which can rotate in the magnetic field of a low resistance current coil. This meter system takes advantage of the voltage across the circuit and the total current flow. The electrodynamometer is ideal for measuring the actual (true) power consumed in a reactive AC device. The torque on the moving coil is proportional to the applied power; the phase angle between current and voltage is automatically compensated in the meter reading.

With the use of these instruments, it is emphasized that a student can become quite involved in motor analyses. This involvement will undoubtedly further his understanding of not only electric energy convertors (motors) but also of the importance of instrumentated analysis.

Activities that can relate to dynamometer testing can be as varied as: testing the performance of rewound slot car motors and the designing of power plants to move large masses at prescribed velocities, i.e., designing electric vehicles or material handling equipment. (See Appendix B for related class activity.)

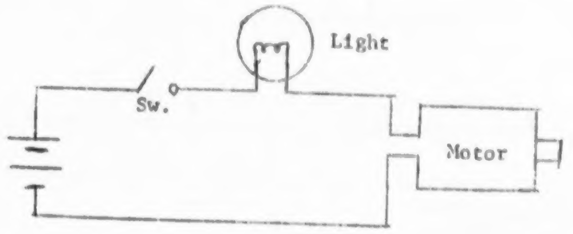
APPENDIX A

Analysis of the DC Motor (Back EMF)

A. Objective(s)
   1. To demonstrate the function of counter EMF in the DC motor
   2. To allow the student to analyze the effects of load on a DC motor

B. Materials and/or equipment
   1. DC power supply - (Batteries or transformer rectifier)
   2. Motor DC (small hobby motor)
   3. Ammeter (0-3)
   4. Flash light bulb (GE #47)
   5. Necessary hookup wire
   6. SPST switch

C. Procedure
   1. Set up the circuit using the above components. (See Figure 1.)



2. Observe and record the following:
   a. With the switch closed, unloaded motor:

Name	Symbol	Reading
1. Load condition in %	L	None
2. Voltage of power supply	E_s	______
3. Ammeter reading	I_m	______
4. Brilliance of light bulb	B_L	Hi Med Lo
5. Power input (in watts)	P_w	______
6. Resistance of armature	R_a	______

   b. With varying loads (from 0% to 100%):

1. Load condition	L	0% (no load)
2. Supply voltage	E_s	______
3. Ammeter reading	I_m	______
4. Brilliance of light bulb	B_L	______
5. Power input (in watts)	P_w	______
6. Calculated armature resistance	R_a	______

Name	Symbol	Reading
1. Load condition	L	50%
2. Supply voltage	E_s	_______
3. Ammeter reading	I_m	_______
4. Brilliance of light bulb	B_L	_______
5. Power input (in watts)	P_w	_______
6. Calculated armature resistance	R_a	_______
1. Load condition	L	100%
2. Supply voltage	E_s	_______
3. Ammeter reading	I_m	_______
4. Brilliance of light bulb	B_L	_______
5. Power input (in watts)	P_w	_______
6. Calculated armature resistance	R_a	_______

3. From your observations answer the following questions:
   a. What was the effect of loading a DC motor with respect to armature resistance, armature current, motor RPM, Back EMF and input power?
   b. Explain why Back EMF is a function of RPM.

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APPENDIX B

Materials Handling Problem

A. Objective(s)
   1. To acquaint the students with electric motor application.
   2. To have the students experiment with dynamic mechanisms (i.e., reduction gears, conveyors).
   3. To introduce the students to concepts of system engineering (design, planning, fabrication and testing).

B. Materials and/or equipment
   1. An electric motor
   2. Necessary tools
   3. Motor dynamometer with electric instrumentation
   4. Construction materials (i.e., wood, metal, cardboard, paper, cloth, rubber inner tubes)
   5. Measuring instruments, stop watch, voltmeter

C. Procedure
   1. The nature of the problem: The class is to break into groups. Each group is to solve the following problem:

      Design a material handling system that will move the most amount of weight with the least amount of energy expended, the longest distance in the shortest time.

      A formula for evaluation of the solutions is:

$$\frac{\text{Weight in lbs.}}{\text{(watt x seconds input)}} \text{ x } \frac{\text{Distance in feet}}{\text{(time of operation in seconds)}}$$

      This formula would yield a factor for comparison of each group's performance.

2. Other criteria:
    a. The groups may select any material to move.
    b. The apparatus must not destroy itself while functioning.
    c. The material moved, or apparatus, may not have to be of practical value. (Rube Goldberg)
    d. A time limit must be set.
    e. Criteria for failure must be set.
3. Observations
    a. Each group is to report and demonstrate to the class the working solution to the problem.
    b. Each group will compute the watt seconds, weight and distance for the evaluative formula.

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the federal government

Understanding Federal educational policy

Marshall Schmitt

Among the many goals that Administrations set for the education of the people in the United States, three stand out as paramount: (1) Get the best instructional materials and procedures into practice; (2) eliminate failures with respect to the education of the disadvantaged; and (3) provide adequate resources in relation to educational need.

The Federal Government does not arrive at its policies in a haphazard fashion. Rather, it has developed over the years a complex system of policy development and accountability, both internally and externally. Some of the factors which enter into such development and accountability include: performance objectives, community involvement, outside technical assistance (management, evaluation, etc.), internal evaluation and an independent education accomplishment audit. By considering these and other aspects of educational program policy, the government is assured of keeping closer tabs on the educational temper of the population, thus enabling it to move in the right direction.

There are many items of concern which influence Federal priorities. These are not always readily recognizable by the layman, so we will list the main ones, as follows:

(1) Learn how to educate deprived children.

(2) Eliminate deficiencies in reading and in other basic skills.

(3) Bring about drastic improvements in the structure, administration and management of our educational system.

(4) Improve vocational education in quality and status.

(5) Extend opportunities for post-secondary education.

(6) Improve the quality of teachers and of teaching.

(7) Eliminate inequities in educational finance, and assure greater stability and adequacy of Federal support systems.

(8) Do justice to the children of black, brown and other minority groups.

(9) Eliminate the causes of student unrest.

(10) Maintain the freedom and diversity of our educational enterprise.

(11) Raise generally the quality of our educational programs and institutions.

Teachers and administrators can play a big part in assisting the government to achieve these goals.

Another area of teacher concern relating to the Federal government is that of proposal development, for obtaining Federal funds and/or equipment for developing and implementing innovative educational programs. Factors influencing proposal development should include: (1) documentation of need (facts and figures—why you need this money); (2) development of a prospectus of the problem (define the problem, get local suggestions and help, suggest procedures for solutions, estimate cost); (3) obtaining of the related Federal regulations and guides through your State Department of Education or from the USOE; (4) determination of the latest Federal policies; (5) determination of the latest Federal priorities; (6) alignment, if possible, of the problem to Federal need (as set forth in the priorities); and then (7) [illegible] and develop the proposal. If these guidelines and procedures are kept in mind, you will have a much better chance of securing the needed support for your programs.

Dr. Schmitt is Educational Specialist for Industrial Arts, US Office of Education, Department of Health, Education and Welfare, Washington, DC.

Industrial arts and compensatory educational programs

John H. Bruce

My remarks will be confined primarily to the compensatory educational programs which are possible through Federal funds under ESEA, Title I.

In the development of Title I projects certain points must be considered:

(1) Identify target areas.
(2) Access learner needs.
(3) Establish priority for services or programs to be provided.
(4) Plan projects or programs in keeping with the needs of the educationally deprived.
(5) Submit project application forms to the State Educational Agency for review and approval.
(6) Project operation.
(7) Evaluation and dissemination of information.

The key to successful Title I project planning and operation is to remember that Title I funds are provided for the support of compensatory educational programs for the educationally disadvantaged. This is categorical aid provided by the US Congress, and these funds must be expended for the purposes intended.

In reviewing project applications at the State Educational Agency, we look for certain characteristics which would reflect a program that is compensatory in nature. In making this determination we might ask the following questions: (1) Have the pupils been properly identified and their educational deprivation determined on the basis of each need? (2) What instructional method is proposed, and how does this method differ from the method normally found in the regular classroom? (3) Will supplies and materials be utilized which are related to the interest and achievement level of the students? (4) Has the pupil-teacher ratio been kept sufficiently low so that each student will be assured of the individual attention that he may need? (5) Has the applicant district defined and clearly stated the objectives for the project, and is there adequate provision for evaluation?

The development of compensatory educational programs funded through ESEA, Title I, is a challenge to each eligible school district. The subject or service areas which may be utilized in providing compensatory programs for disadvantaged children are unlimited. The extent to which a subject or service area becomes involved in the compensatory program is directly dependent upon the interest and effort of the administrative and/or instructional personnel who work within the district service area. The operation of industrial arts programs as a component of Title I projects has not been extensive in the State of Kentucky. However, there are projects in operation in some of our school districts which would reflect the desirability of offering industrial arts educational opportunities as a phase of the compensatory program. On the junior high school level, the industrial arts compensatory program may be identified and offered as a distinct subject or service. On the elementary level the industrial arts program may be offered as an integrated part or as a means of generating interest for the total compensatory program.

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Industrial arts in Federally-sponsored research

James R. Hastings

With the adoption of the Cooperative Research Act in 1954 and the subsequent funding authorized by Congress under Title IV of The Elementary and Secondary Education Act of 1965 and its amendments, educators in all subject matter fields and levels have been provided the opportunity to make use of a tremendous financial resource through Federal funding.

One of the main ways the US Office of Education attempts to help improve education is by supporting research and research-related activities. To accomplish this, the Bureau of Research has been established to review proposals, approve projects and administer funds for education research throughout the country through its various divisions. The Bureau of Research has five divisions to process proposals and monitor contracts and grants. The five divisions are: Elementary and Secondary Education Research, Comprehensive and Vocational Education Research, Higher Education Research, Information Technology and Dissemination and Educational Laboratories. Small-project research projects are administered through the regional centers and laboratories. A very comprehensive explanation of the various divisions and research agencies is contained in the US Office publication, Office of Education Support of Research and Related Activities (17).

In spite of the provision made in the US Office of Education for the promotion and support of research, the truth of the matter is that there is a great paucity of funded research in industrial arts. Rowlett (12), Evans (5), Strickler (14) and Suess (15) comment on some of the apparent reasons for the limited amount of research in our field beyond that which is done for academic degrees. They also indicate the crying need for more and better-quality research and the favorable trends which seem to be developing.

In order to determine the extent to which industrial arts personnel have attempted to take advantage of Federal funding, I reviewed a number of compilations of research studies done in our field since funding under the Cooperative Research Act has been available. The following facts serve to illustrate and emphasize the limited use which our field has made of Federal research funds.

A directory of Cooperative Research studies completed prior to 1966, listing several hundred studies, contained only one industrial arts study. In the report from ERIC center by Strickler (14) in 1966, which included over 300 studies completed since 1960, only three Federally-funded studies are listed. Jacobsen's (8) investigation in 1966, covering 200 studies in industrial arts teacher education, included only five funded studies. The most recent report by Householder and Suess (7), put out by the ERIC Clearinghouse for Vocational and Technical Education at Ohio State University, includes approximately 220 studies, only three of which are Federally-funded through 1969.

Since funding for innovative programs can be obtained through Title III of the ESEA, I also checked the directory of projects listed in Pacesetters in Innovation, 1966-69 (21). Of the 600 studies listed, I found only three related to industrial arts. Two of these were in elementary school industrial arts.

A few funded research studies have not been reported, no doubt due to the final report not being submitted to ERIC or otherwise reported. Since 1963 there have been approximately 17 industrial arts projects funded in amounts ranging from $3,776 to over $200,000 through the US Office.

Nature of funded researches. In reviewing the funded studies, the distribution of purposes of these projects is reflected in the table below:

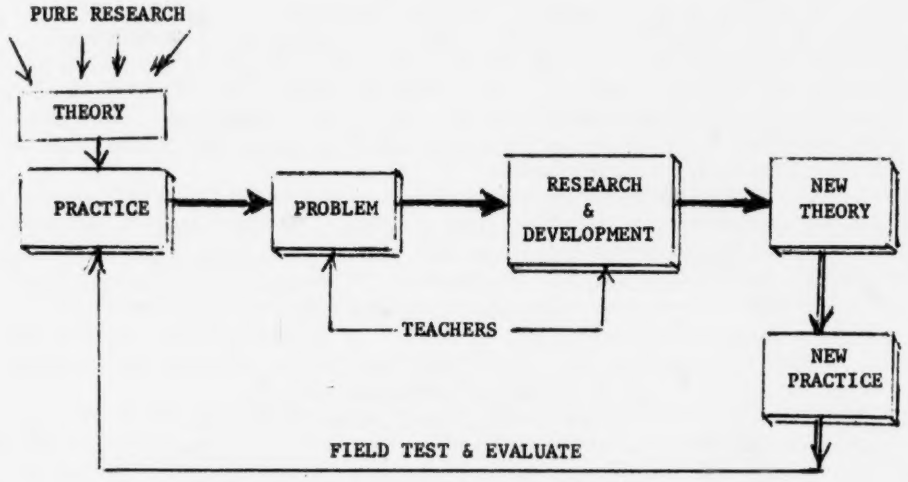
Subject	No. Studies
Curriculum	5
Plastics	1
Skill Development	1
Ind. Arts - Voc. Ed.	2
Teacher Education	1
Culturally Disadvantaged	2
Media and TV	3
Elementary IA	2
	17

In relation to the priorities which influence Federal funding, which Dr. Schmitt has presented, we can immediately see several areas of concern where industrial arts could make a definite contribution and where we might well direct our attention in developing proposals for Federally-funded projects. I am referring to such subjects as: Teaching the slow learner, instructing the inner-city student, teaching the culturally disadvantaged, and demonstration projects which will generally raise the level of our educational program both in content and methodology.

Over the past three years significantly larger sums of money have been made available through Federal funding for research and development in all areas (10). This trend supports some of the conclusions and recommendations emanating from the National Conference on Research in Industrial Arts (15), which states that we are in great need of research studies which will demonstrate effective means of applying some of the new curriculum theories as proposed by DeVore (3) and others. (Although we are in great need of studies which are interdisciplinary and can produce new theory, we are also somewhat like the old farmer who said, "Son, don't tell me nothin' more about farmin', -- I already know more than I'm able to do.")

Need for applied research and development. We have only to look at the annual reports of some of our major industries to realize the importance attached to and the investment made in research and development which requires the field test and evaluation of new materials, products and procedures. Recent articles by Turner (14) and Earl (4) draw interesting parallels between the efforts of industry and education in research and development.

The diagram shows the relationship and importance of the effect of research on educational practice.



I

In view of the rapid changes which need to take place in our field, it seems obvious, in view of the evidence, that industrial arts needs to make a greater effort to obtain support for many more pilot and demonstration projects which can be evaluated and the information disseminated to improve the practices in our field. This can be accomplished in part if we submit more applications and proposals to the Bureau of Research.

Contributions of funded projects. The American Industry Project at Stout State and the Ohio Industrial Arts Curriculum Project, being conducted jointly by Ohio State and the University of Illinois, are examples of two large-scale curriculum development projects which promise to have a major impact on our field. These are examples of well-conceived research and development projects. It is also entirely possible to have small research projects of under $10,000 funded through regional centers which can achieve significant results.

The Directed Field Study in Industry for the Preparation of Industrial Arts Teachers project (6), which I directed, was extremely successful in developing a new procedure and set of experiences for identifying concepts of industry and an understanding of the structure of industry in the minds of undergraduate industrial arts majors. The true significance of this study has not, however, been fully reported. Its significance lies in the process used to identify industrial concepts and then use these for developing curriculum units. The accompanying Figure II illustrates the structure of industry used in conducting the 8-week experience for our students. Figure III illustrates the transposing of curriculum development elements which are utilized in the conceptual approach to curriculum work as developed in the project.

As I survey the present situation, one of the major challenges to our field at this time is to carry on more applied research using the theory and information we presently have to prove out and evaluate some of the ideas and theories in existence. The growing body of research which has already been completed by industrial arts personnel attests to the fact that we have the interested people and the capability to carry out research.

What is most needed at this point is the preparation and submission of more research proposals to support needed projects to give us the time and independence of action we need to accomplish our goals.

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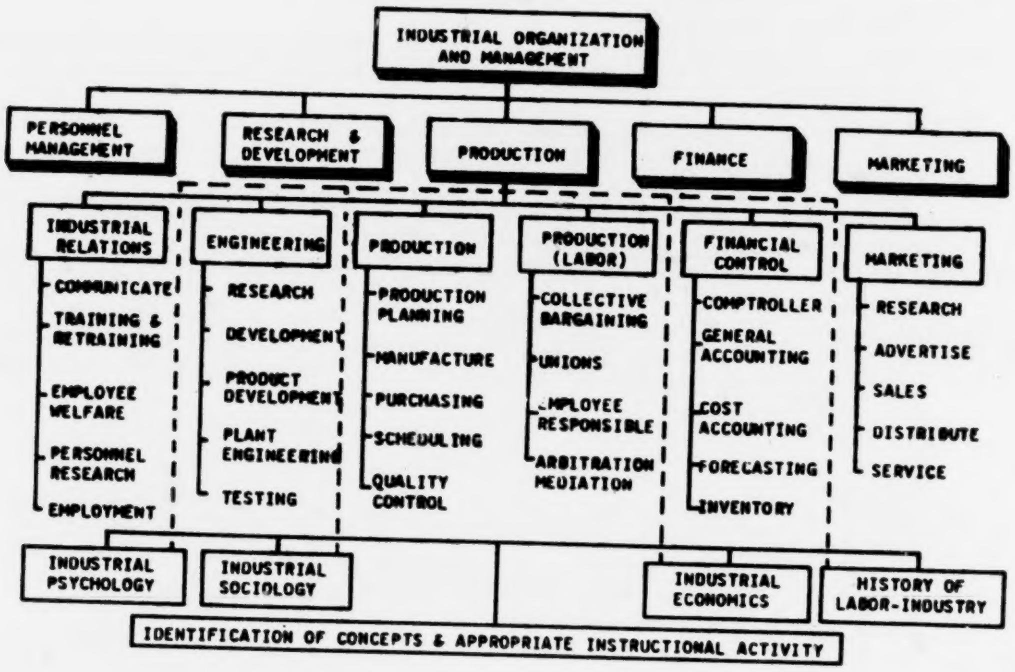
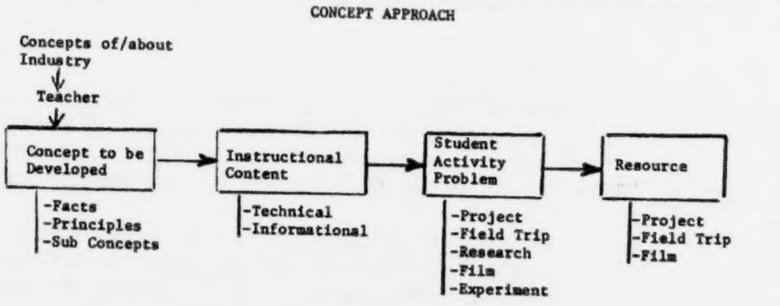
(3) DeVore, Paul, "Discipline Structures and Process: A Research Design for the Identification of Content and Method", Journal of Industrial Teacher Education, Winter 1970, pp. 21-31

FIGURE II

COMMON ELEMENTS OF INDUSTRY


INDUSTRIAL ORGANIZATION AND MANAGEMENT
PERSONNEL MANAGEMENT
RESEARCH & DEVELOPMENT
PRODUCTION
FINANCE
MARKETING
INDUSTRIAL RELATIONS
COMMUNICATE
TRAINING & RETRAINING
EMPLOYEE WELFARE
PERSONNEL RESEARCH
EMPLOYMENT
ENGINEERING
RESEARCH
DEVELOPMENT
PRODUCT DEVELOPMENT
PLANT ENGINEERING
TESTING
PRODUCTION
PRODUCTION PLANNING
MANUFACTURE
PURCHASING
SCHEDULING
QUALITY CONTROL
PRODUCTION (LABOR)
COLLECTIVE BARGAINING
UNIONS
EMPLOYEE RESPONSIBLE
ARBITRATION MEDIATION
FINANCIAL CONTROL
COMPTROLLER
GENERAL ACCOUNTING
COST ACCOUNTING
FORECASTING
INVENTORY
MARKETING
RESEARCH
ADVERTISE
SALES
DISTRIBUTE
SERVICE
INDUSTRIAL PSYCHOLOGY
INDUSTRIAL SOCIOLOGY
INDUSTRIAL ECONOMICS
HISTORY OF LABOR-INDUSTRY
IDENTIFICATION OF CONCEPTS & APPROPRIATE INSTRUCTIONAL ACTIVITY


TRADITIONAL APPROACH

CONCEPT APPROACH
Operations
Processes
Materials
Teacher
Student Activity
-Project
-Materials
-Operations
-Processes
Instructional Content
-Demonstration
-Technical
-Related
Resources
-Films
-Visits
-Charts
-Speaker
Outcomes
-Attitude
-Understanding
-Concepts (?)
Concepts of/about Industry
Teacher
Concept to be Developed
-Facts
-Principles
-Sub Concepts
Instructional Content
-Technical
-Informational
Student Activity Problem
-Project
-Field Trip
-Research
-Film
-Experiment
Resource
-Project
-Field Trip
-Film

Figure III

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(20) US Office of Education, Small Project Research and Winning a Research Bid (reprint American Education, May 1968) (OE-12033) $.05, Supt. of Documents.

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Mr. Hastings is on the faculty at State University College, Oswego, NY.

The Vocational Education Amendments of 1968

Gerald T. Antonellis

The purpose of the Vocational Education Amendments of 1968 (PL 90-576) is to provide financial assistance to schools under public supervision and control in the field of vocational education. Funds are to be used to improve, strengthen and expand educational programs designed primarily to fit individuals for gainful employment in recognized occupations.

The implementation of the Act in Massachusetts will assist schools: To maintain, extend and improve existing programs of vocational education; to develop new programs of vocational education; to provide part-time employment for youths who need the earnings from such employment to continue their vocational training on a full-time basis; to provide more vocational education opportunities, for persons of all ages in all communities of the State, which are of high quality, realistic in the light of actual or anticipated opportunities for gainful employment, and suited to the individual's needs, interests and ability to benefit from such training;

to provide vocational education for persons attending high school, vocational education for persons who have completed or left high school and who are available for full-time study in preparation for entering the labor market, vocational education for persons who have already entered the labor market and who need training or retraining to achieve stability or advancement in employment, vocational education for persons who have academic, socioeconomic or other handicaps that prevent them from succeeding in the regular vocational program, construction of vocational education school facilities, ancillary services such as teacher training, demonstrations and experimental programs, development of instructional materials, program evaluation, research and guidance activities;

Emphasize the development of new programs in general (comprehensive) high schools to reach students not now being served--care to be exercised not to duplicate but complement present offerings and to crossdiscipline programs (home economics/business, industrial arts/business) when and where possible;

utilize more extensively existing vocational education facilities by making them available to high school students from both public and private sectors on a part-time, late-afternoon, early-evening basis;

special programs for potential school-leavers;

post-secondary programs be expanded (clearer and more definite arrangements between vocational education and community college);

adult occupational education of an upgrading or transfer of skills;

programs for the disadvantaged;

guidance/and counselling services greatly expanded to include the in-school youth below the 9th grade (primary, elementary and junior high school) and adult along with out-of-school programs for general guidance personnel to acquaint them with vocational guidance concepts;

programs for handicapped people in a cooperative effort with other agencies who handle same;

provide meaningful research and implementation of same;

provide programs for retraining, and exemplary programs (example: pilot program that may not be new; however, it is new to system – a new way to (bridge) between school and earning a living, whereas, innovative must be new, brand-new);

personnel development (will receive prime attention) will consist of programs in teacher education where a teacher or potential teacher will be able to obtain training and receive a Bachelor to a Doctorate; and

personnel development programs for the development of administrators and supervisors.

Division of occupational education. The above is in general the plan for the next five years. Goals are being set for implementation of these plans on annual progression basis (PPBS-Planned Program Budget System). Leadership at the State level will have as its primary function assistants to the local schools to implement this plan. The Administration of Occupational Education at the State level must be completely altered due to Chapter 837 Acts of 1969 of the Commonwealth of Massachusetts, establishing a Division of Occupational Education within the Board of Education designating said as the sole State Agency responsible for the administration of Vocational Education in the Commonwealth: (Associate Commissioner, Directors of Post-Secondary and Secondary Education, Assistant Director of Disadvantaged and Handicapped, Coordinator of Comprehensive High School Programs, Chief of Business and Office Education.)

(Definitely the present staff, with depleted numbers and inadequate pay scales, is inadequate to meet the mandates of this new law.)

Kinds of activities that qualify.

(1) Paying salaries and necessary approved expenses of local school personnel including teachers, coordinators, supervisors, vocational guidance counselors, teacher trainers, directors and others.

(2) Acquiring or producing, disseminating and evaluating instructional materials and teaching aids.

(3) Securing necessary educational information and data as a basis for the proper development of vocational education programs to insure adequate vocational guidance and counselling.

(4) Making occupational studies and surveys needed for the planning and development of vocational education.

(5) Acquiring, maintaining and repairing instructional equipment.

(6) Paying necessary costs of transportation of students.
(7) Conducting work experience education programs.
(8) Paying approved expenses of consultants or members of advisory committees.
(9) Maintaining adequate programs of administration, supervision and teacher training.
(10) Constructing area vocational education school facilities, which include paying for interest in land on which such facilities are to be constructed.

Agencies eligible to apply for assistance. A Vocational Education project is defined briefly to mean a service, a separate course, a sequential combination of courses arranged into a special vocational curriculum, or one or more vocational curricula offered as a vocational education program.

Any secondary school, community college, junior college or school for adults under public supervision and control, or the superintendent of any regional or county school, or public college or university may submit an application for approval (special forms for contracts with private institutions will be available). (Refer to addendum at conclusion of paper.)

Supplementary funding evaluation system for Massachusetts vocational educational programs: (in reference to approved State Plan)

State plan (information):

Part A - General Provisions: 1. Authorizes appropriations under parts B and C. 2. Estimated appropriation $868,000 for Disadvantaged (Socioeconomically)

Part B - State Vocational Education Programs (Set-asides - 40%)

(1) Estimated appropriation $7,703,500

A. 10% Handicapped ($770,350) to work cooperatively with agencies, organizations and institutions concerned with handicapped persons (Vocational Rehabilitation, Bureau of Special Education of the Department of Education, Mass. Association for Retarded Children, Morgan Memorial Goodwill Industries, Jewish Vocational Service, Model Cities Programs, State Department of Public and Mental Health, United Community Workshops, Federal Department of Health, Education and Welfare, Division of Research, Training Programs and Educational Services (of same HEW), and not limited to the above, but with other pertinent agencies as the need arises.)

B. 15% Disadvantaged ($1,155,525) persons who have academic, socioeconomic, cultural or other handicaps that prevent them from succeeding in regular vocational education programs designed for persons without such handicaps, and who for that reason require specially-designed educational programs and related services or both in order for them to benefit from a vocational education program or consumer and homemaking education. The term includes persons whose needs for such programs or services result from poverty, neglect, delinquency, or cultural or linguistic isolation from the community at large, but does not include physically or mentally handicapped persons (as defined below) unless such handicapped persons also suffer from the additional handicaps described in this paragraph.

Handicapped persons: Persons who are mentally retarded, hard of hearing, deaf, speech-impaired, visually handicapped, seriously emotionally disturbed, crippled or other health-impaired persons who by reason of their handicapping condition cannot succeed in a regular vocational or consumer and homemaking educational program without special educational assistance or who require a modified vocational or consumer and homemaking education program.

Disadvantaged persons: Agencies or organizations and institutions concerned with disadvantaged persons--Public Health, Public Welfare Commission for Blind, Veterans Services, Mental Health, Department of Correction, Division of Youth Services, Division of Employment Security, Commission for Aging, Commission for Discrimination, and private agencies approved by the Board of Education. (Disadvantaged include persons who are socioeconomically handicapped, inmates of correctional institutions, aged, migrants, juvenile delinquents, dropouts, racial, linguistic and other minorities.)

Part C - Research and Training in Vocational Education
(1) Estimated appropriation: $737,800
a. 50% reserved by USOE ($368,000)
b. 50% to States - Mass. ($368,000)

Part D - Exemplary Programs and Projects

(1) Estimated appropriation (two-year availability) $256,420
a. 50% reserved by USOE ($128,210)
b. 50% to States - Mass. ($128,210)

Part E - Residential Schools
(1) Estimated appropriation $-0-

Part F - Consumer and Homemaking Education
(1) Estimated appropriation $325,500
a. At least 1/3 to be used in economically-depressed areas or areas with high rates of unemployment, designed to assist consumers and to help improve home environment and quality of family life ($108,300)

Part G - Cooperative Vocational Education - A cooperative workstudy program of vocational education for persons who, through a cooperative arrangement between the school and employers, receive instruction, on-the-job training, by the alternation of study in school with a job in a related occupational field, but these two experiences must be planned and supervised by the school and employers so that each contributes to the student's education and to his employability. Work periods and school attendance may be an alternate half-day, full-days of the week, or other periods of time in fulfilling the cooperative vocational education work-study program. Estimated appropriation $277,686

Part H - Work-study Programs for Vocational Education Students - A program which provides employment for a student in good standing and in full-time attendance who is in need of the earnings from such employment to commence or continue his vocational education (not necessarily job-related).

Estimated appropriation $277,000. Total estimated appropriation: $9,868,796.

Applications evaluated on a method, taking the following into consideration:

Manpower needs - Applications will be evaluated in terms of the rank of manpower needs compared to all occupational needs on a state level. Data will be from the Massachusetts Division of Employment Security-published 30-day job openings list.

Those occupations representing the top 1/6 positions of the list will receive 30 points, next 1/6 24 points, etc. Point scale: 1st 1/6-30 pts, 2nd 1/6-24 pts, 3rd 1/6-18 pts, 4th 1/6-12 pts, 5th 1/6-6 pts, 6th 1/6-0 pts.

Evaluation of vocational needs - Areas that qualify: Physically handicapped, mentally handicapped, emotionally handicapped, socio-economically handicapped, linguistically handicapped, academically handicapped.

Scoring: 15 pts. for programs with a combination of three or more areas; 9 pts. for programs with combination of two areas; 6 pts. for one area; 0 pts. for regular programs. Note: Programs must be designed to meet these specific needs, not revised to accommodate persons designated as disadvantaged or handicapped.

Excess costs - Projects which have evidence of costs which are unusual compared to other projects or programs within the educational system will be rated as follows: severe-15 pts; great-12 pts; average-9 pts; mild-6 pts; slight-3 pts; and none-0 pts. Due consideration will be given to summer employment of teachers, extended employment or released time to conduct special program emphasis (cooperative education, planning new programs, etc.), high expenditures for initial equipment acquisition, new teachers, etc.

Additional considerations: Schools in economically depressed areas will receive 5 pts, schools in high unemployment (6%) areas will receive 5 pts, and programs that are unusual, innovative, demonstrative or pilot projects will receive 10 pts. (Therefore, 20 pts. are reserved above and beyond for special (designated) areas. A school not designated can only receive a maximum of 80 pts.)

Relative ability to pay - The relative ability of each community to pay vocational costs shall be determined by dividing the per-pupil equalized assessed valuation data from latest published reports of the Massachusetts Department of Education by the secondary per-pupil expenditure. This figure in decimal form will then equate to points according to the following chart: .080-.100 - 20 pts, .065-.079 - 16 pts, .050-.064 - 12 pts, .035-.049 - 8 pts, .020-.034 - 4 pts, .0-.019 - 0 pts.

Regional schools and programs: valuation and per-student expenditure data will be pro-rated according to number of secondary school children in the towns and cities of member communities and then averaged.

Summary of rating scale.

	Total points possible
(1) Manpower Needs	30
(2) Vocational Needs	15
(3) Excess Costs	15
(4) Relative Ability to Pay	20
Total Points	80
(5) Additional Considerations	
Schools in economically depressed areas	5
Schools in high unemployment areas	5
Demonstration on Pilot Programs	10
Total Points	20
Total Points Possible	100

All proposals scoring fewer than 40 on the weighted scale will receive no Federal funds, and they will be so notified in writing by the Associate Commissioner. All proposals scoring above 40 points will be funded according to the following table:

Score	% of Federal Funds
100	100
90	90
80	80
70	60
60	40
50	20
40	
30	No Support
20	
10	
0	

A ratio between the total amount of money of all proposals scoring above 40 points and the total amount of Federal funds allotted to that specific level (secondary, post-secondary, adult-disadvantaged, handicapped, etc.) will be determined. This ratio will then be applied to the percentage shown in the table above. This table is subject to change depending on amounts of final funds appropriated.

USOE Instructional Codes and Titles -- Office Occupations (14,000)

14.0100	Accounting and Computing
14.0200	Business Data Processing Systems
14.0300	Filing, Office Machines and General Office Clerical
14.0400	Information Communication
14.0500	Materials Support, Transporting, Storing and Recording
14.0600	Personnel, Training and Related
14.0700	Stenographic, Secretarial and Related
14.0800	Supervisory and Administrative Management
14.0900	Typing and Related
14.1000	Miscellaneous Office (Specify)
14.9900	Other, NEC (Specify)

Definitions.

Adult vocational education. Vocational education designed primarily for employed persons which is designed to provide training or retraining to insure stability or advancement in employment of such persons.

Ancillary services and activities. Services and activities necessary to assure quality in all programs, services and activities provided for under the Act, the regulations and the State Plan, such as: State administration and leadership; supervision of instructional programs at the local level, including vocational education programs; evaluation of programs; training of teachers and other program personnel; special demonstration and experimental programs; development of curricula and instructional materials; and research related to any of the services and activities above.

High school or secondary school. Does not include any grade beyond grade 12.

Specialized secondary school--A specialized high school used exclusively or primarily for the provision of vocational/technical education to persons who are available for full-time study in preparation for entering the labor market. Regular or comprehensive secondary school--A high school, designed to meet the educational needs of youth providing vocational education in fields(s) to persons who are available for full-time study in preparation for entering the labor market. Combination specialized secondary school and technical or vocational school--A school that meets the criteria for specialized secondary school and for a post-secondary vocational school.

Community or junior college. A junior or community college which provides vocational education in occupational field(s), under the supervision of the State Board, leading to immediate employment but not leading to a baccalaureate degree.

College or university. A college or university which provides vocational education in occupational field(s), under the supervision of the State Board, leading to immediate employment but not leading to a baccalaureate degree.

Area vocational education school. Any public or private institution which falls into any one of the following categories:

(1) A specialized high school used exclusively or principally for the provision of vocational education to persons who are available for study in preparation for entering the labor market, or

(2) The department of a high school exclusively or principally used for providing vocational education in no fewer than five different occupational fields to persons who are available for study in preparation for entering the labor market, or

(3) A technical or vocational school used exclusively or principally for the provision of vocational education to persons who have completed or left high school and who are available for study in preparation for entering the labor market, or

(4) The department or division of a junior college or community college or university which provides vocational education in no fewer than five different occupational fields, under the supervision of the State Board, leading to immediate employment but not necessarily leading to a baccalaureate degree.

An "Area vocational education school" shall be available to all residents of the State or an area of the State designated and approved by the State Board. In the case of a technical or vocational school or a division of a junior college or community college or university, such school must admit as regular students both persons who have completed high school and persons who have left high school.

Consumer and homemaking education. Education designed to help individuals and families improve home environments and the quality of personal and family life, and includes instruction in food and nutrition, child development, clothing, housing, family relations and management of resources with emphasis on selection, use and care of goods and services, budgeting and other consumer responsibilities.

State-Massachusetts

Table 1

Fiscal Year-1970

Estimated Allocation of Funds
for State Vocational Education Programs

Program/Purpose	Total Funds	Federal Funds	State Funds	Local Funds
Part B State Programs				
Secondary	$42,100,000	$2,100,000	$10,000,000	$30,000,000
Post Secondary	6,155,525	1,155,525	2,500,000	2,500,000
Adult	2,850,000	100,000	250,000	2,500,000
Disadvantaged	1,755,525	1,155,525	300,000	300,000
Handicapped	1,070,350	770,350	150,000	150,000
Contracted Instruction	-	-	-	-
Guidance and Counseling	400,000	100,000	150,000	150,000
Construction of Area Vocational Schools.	26,500,000	1,500,000	10,000,000	15,000,000
Ancillary Services (Total)	1,977,100	822,100	405,000	750,000
Administration and Supervision	780,000	300,000	180,000	300,000
Evaluation	375,000	150,000	75,000	150,000
Teacher Training	275,000	125,000	50,000	100,000
Research and Demonstration Projects	280,000	130,000	50,000	100,000
Curriculum Development	267,100	117,100	50,000	100,000
Total	$82,808,500	$7,703,500	$23,755,000	$51,350,000
Section 102(b) State Programs				
Disadvantaged	$ 1,068,000	$ 868,000	$ 100,000	$ 100,000

Program/Purpose		Total Funds	Federal Funds	State Funds	Local Funds
Part C	Research (Total)	$ 493,900	$ 368,900	$ 25,000	$ 100,000
	ROU	81,000	56,000	25,000	-0-
	Grants and Contracts	412,900	312,900	-0-	100,000
Part D	Exemplary Programs (Total)	128,210	128,210	-0-	-0-
	Planning	28,210	28,210	-0-	-0-
	Operating	100,000	100,000	-0-	-0-
Part E	Residential (State) (Total)	-0-	-0-	-0-	-0-
	Planning	-0-	-0-	-0-	-0-
	Construction	-0-	-0-	-0-	-0-
	Operation	-0-	-0-	-0-	-0-
Part F	Consumer and Homemaking (Total)	625,500	325,500	100,000	200,000
	Instruction	470,000	200,000	90,000	180,000
	Ancillary	155,500	125,500	10,000	20,000
Part G	Cooperative Programs (Total)	427,686	277,686	50,000	100,000
	Instruction	382,686	252,686	40,000	90,000
	Ancillary	45,000	25,000	10,000	10,000
Part H	Work-study (Total)	317,000	217,000	-0-	100,000
	Student Compensation	307,000	207,000	-0-	100,000
	Administration	10,000	10,000	-0-	-0-

Occupational field. A group of recognized and new and emerging occupations having substantial similarity in the work performed; similarity in the abilities and knowledge required of the worker for successful job performance; similarity in the tools, machines, instruments and other equipment used and similarity in the basic materials worked on or with. The term is applied in the case of Federal participation in the construction of an area vocational school, to determine whether a department of a certain type of high school, or a department or division of a junior college, community college or university provides "vocational education in no fewer than five different occupational fields." The purpose is to assure that such schools will have offerings that will afford prospective students of varying interests a reasonably broad choice of the type of occupation for which they are to be trained. Determinations of what is an "occupational field" will be made in light of this purpose.

Manpower Needs

DES Code	Occupational Title	Need		Points
201 202 209	Stenography	709	6/6	30
600-619	Machine & Related Work	432	5/6	24
075	Nursing	374		
210-219	Bookkeeping	271		
786-87	Machine Sewing	252	4/6	18
203-216	General Clerical	217		
311	Food Serving	160		
720-729	Assemble & repair electronic equipment	156		
301-306	Day Worker or Domestic Serv.	132		
381-389	Bldg. Cleaning & Rel. Serv.	129	3/6	12
550-563	Chemical Processing & Related Services	119		
250-289	Sales Work	114		
291-299	Salesclerk & Related Service	114		
361-9	Apparel & Furnishing Service	96		
860	Carpentry Installing & Repairing	94		
820-829	Electrical Assembling	85	2/6	6
760-769	Machining, fabrication & repair of wood products	81		
804	Sheet metal work	79		

DES Code	Occupational Title	Need		Points
810 & 819	Welding	75	1/6	0
355	Hospital Attendant work & related service	73		
213	Data Processing	69		
323	Maid & related service	64		
620	Repair motorized vehicle	60		
780-81	Upholstering	55		
313-4-5	Cooking - Hotel & Restaurant	54		
782-789	Fabrication & repair textile & leather	41		
650-659	Printing	36		
584-599	Leather & textile processing	35		
740	Painting, decorating & related work	34		
862	Plumbing, gasfitting & steamfitting	32	1/6	0
078	Medical & dental technology	26		
500	Metal Processing & electroplating	22		
807	Body work - Transp. equip.	14		
332	Beauticians services	12		
861	Mason & tile services	10		
753-4	Fabrication, repair of rubber & plastic products	10		
142	Commercial Designing	2		

Participation of students in nonprofit private schools. The State will assure participation of students in nonprofit private schools in accordance with the following: Each program will be designed to meet the vocational needs of students within the geographic area according to the following criteria as specified in Regulation 102.7: (a) dual enrollment, educational radio and television, and professional and subprofessional services; (b)The needs of the students, the number of such students who will participate and the types of vocational education services which will be provided for them will be determined after consultation with persons knowledgeable of the needs of the students on a basis comparable to that used in providing such vocational education services to students enrolled in private nonprofit public schools. The application shall indicate the number of students enrolled in private nonprofit schools who are to participate in each program and project proposed by such agency and degree and manner of their expected participation. These figures will be reported annually to the Division of Occupational Education; (c) Public school personnel may be provided only when not provided by the private school. The State Board or LEA will maintain administrative control over services. No salaries of teachers or other employees.

Opportunity for hearings on local applications. The State Board shall designate the Vocational Bureau to arrange hearings, when required, on local applications. The hearings will be held in the office of the Bureau of Vocational Education after two weeks' notice, before the director, program planning supervisor and other related staff members. The local education agency will be notified in writing of date, time and place of hearing. The local agency may present additional evidence, and witnesses from professional, business and community-related organizations as arranged by the local educational officer. The local education agency will be notified in writing of all outcomes of hearing. Request for appeal hearings must be made within one week of receipt of the local funding disposition notice. Disposition of appeals will be made and the local authorizing agent notified within five days of the hearing.

Mr. Antonellis is with the State Department of Education, Boston, Massachusetts.

Industrial arts in innovative Federal programs

Larry T. Ivey

Educators, government leaders and concerned citizens have repeatedly pointed out the apparent gap between education and technological advancement in America. For years education has remained stagnant while society has progressed with ever-increasing strides.

Stagnancy of education, coupled with progression of society, has brought the gap between them to a prominent forefront in American education and government.

The advent of the Space Age and of industrial automation has forced educators to play a catch-up role in an effort to overcome the vast gap now existing between education and modern society in America.

In 1965, the United States Congress, reacting to problems in education, enacted the Elementary and Secondary Education Act (ESEA). This act provided for appropriations of large sums of money by the Federal government. Money was to be allocated to various state and local educational agencies to be expended for educational programs considered necessary for improving schools and education throughout the United States.

There are several Titles under the Elementary and Secondary Education Act of 1965, each one concerned with specific areas of education. There are many projects which come under the various Titles of ESEA, but no attempt will be made here to relate to any project or program other than Title III, ESEA. Briefly stated, the purpose of Title III is as follows:

> Objectives of the Title III program of the Elementary and Secondary Education Act, called PACE (Projects to Advance Creativity in Education), are designed to encourage school districts to develop imaginative solutions to educational problems; to utilize research findings more effectively; and to create, design and make intelligent use of supplementary centers and services. Primary objectives are to translate the latest knowledge about teaching and learning into widespread educational practice and to create an awareness of new programs and services of high quality that can be incorporated in school programs. Therefore, PACE seeks to (1) encourage the development of innovations, (2) demonstrate worthwhile innovations in educational practice through exemplary programs, (3) supplement existing programs and facilities. The heart of the PACE program is in these provisions for bringing a creative force to the improvement of schools and for demonstrating that better practices can be applied. Since the innovative and exemplary programs supported by PACE are intended to contribute substantially to educational improvement, priority in funding is given to those projects which offer the greatest promise of solving persistent problems, thereby advancing educational excellence.*

Title III of the Elementary and Secondary Education Act also stipulates that each state will set aside and allocate 15% of its funds for education of the handicapped. Each State is responsible for establishing a State plan which includes the 15% allocation for handicapped children.

As each state develops its plan, careful consideration is given to priorities and student needs. State plans are based on information from reviewing overall State needs and objectives. Long-range goals become very important, and a total plan for educational improvement evolves to be implemented under the coordination of each State Department of Public Instruction. One of the more important stipulations of Title III is that all projects must be initiated by a local educational agency. Each project within a given state is funded separately on the merits of each individual project. The state then accepts funds for all projects within its boundaries and allocates funds to each local educational agency.

In the past, each local agency submitted a proposal to the US Commissioner of Education. That has now changed and each local agency now submits proposals to its respective State Department of Public Instruction.

There are several key factors to be applied in developing program proposals for Title III funding:

(1) Each local agency must conduct a comprehensive needs assessment in order to determine priorities. Projects must relate to critical needs within the local system. The studying of needs and establishment of priorities can best be accomplished by a coordinated effort between local, state and Federal agencies. Close coordination during development and planning of a project will assure each level of government some understanding of the purpose of a particular project and will increase chances for that project to be approved. Simply stated, the first step in planning a Title III project is to ask, "What are the problems and needs of the local education agency?"

(2) Pre-planning is essential to every project. The establishment of specific as well as general objectives of the project should be included in planning. Objectives should be stated in terms of student behavioral changes to be brought about by the project. Careful

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*A Manual for Project Applicants and Grantees, Title III Elementary and Secondary Education Act (Revised), Washington, DC: US Office of Education, 1967, p. 1.

attention to ways and means of creating changes within students will yield valuable results during evaluation of the project. Step-by-step procedures for effecting changes in student behavior will provide invaluable guidance for project personnel during operation of any project. Assurance for reaching expected outcomes is greatly enhanced by knowing what the anticipated outcomes are and how those outcomes will be reached.

My personal contact with Title III projects has been extensive, and the result of this contact has revealed one very important factor: "There never seems to be enough planning in terms of student behavior and expected outcomes." My strongest recommendation to any agency planning a Title III Project is this: State your specific behavioral objectives very clearly; list all of your objectives; indicate a definite plan for implementing those objectives; and state what the anticipated outcomes will be in terms of student performance. This second factor in planning a project might be more easily understood when stated in the form of the following question: "What do you want to do about the problems and needs of your local system, and how do you plan to solve those problems and needs?"

(3) The third and final factor I wish to share with you concerns a very important phase of any and every educational program. This factor is evaluation. No project can survive without it, and very few ever improve unless they have good evaluation. Evaluation logically begins with the objectives of the project. The more clearly and specifically these objectives are stated, the more obvious will be the kinds of data that can be collected. Any objective, for which it seems that no data will be available, should be either revised or omitted. Such objectives may be beyond the scope of the project, too idealistic, too vague or too general. Simply stated, evaluation is knowing how and when you have solved specific problems or met certain needs. This should not imply that evaluation is simple, for it is highly complex and requires extensive consideration in both pre-planning and operation of a project. There are various modes for evaluating Title III projects, and the one you select should be determined by the project itself. No matter which evaluation scheme you select, plan it carefully. Include it in all of your project plans. Make certain that you have included methods for obtaining both objective and subjective information. Include in your data both quantitative and qualitative changes, and specify how each segment of the data collected will count in the final evaluation report. I would urge anyone concerned with evaluation to collect and document each and every instance of educational change attributed to your particular project. You can always have too little evidence of change, but you can never have too much.

I fully realize that I have only touched upon the many problems which must be confronted when planning a Title III project. I hope I have helped you in some small way, and perhaps I can offer more assistance by explaining some of the problems and solutions to problems which I have encountered during my two years with Title III, ESEA.

My particular concern with Title III has been in an "Elementary Industrial Arts Project" in Bertie County, North Carolina. Our project officially began June 1, 1968. However, planning was initiated as early as 1966.

The first concern for most project directors, and I was no exception, was in locating and employing competent personnel. Success hinges on the quality of persons involved in any project. I was very fortunate in securing a full staff of excellent educators. I have four (4) curriculum coordinators to assist me in conducting project activities.

I submit to you that the first requirement in selecting staff is to find persons who believe in what you are attempting to do. Second, now that you have found those persons, give them credit for their abilities and let them share in all decisions affecting the project. I have found the key to a good project lies in cooperative team effort.

Another element vital to a project's success concerns human relations. When changes are introduced into an educational system, you can be assured of encountering opposition. My advice is to accept the opposition and consider its reasons. Begin by working with those teachers and other personnel who believe in the change and are willing to participate in it. If you have a good program, the optimists will be confirmed and the skeptics will be enlightened.

You must be many things when you become a Title III project director, and no one can tell you how best to perform your task. You must be an educator first and then attempt to be a writer, public relations expert, salesman, bookkeeper, purchasing agent and many more.

Above all, you must have confidence in your staff, believe in your program, collect all of the feedback you can get and be ready to make changes if and when they become apparent.

One last thought: If you are the driver of a vehicle of education, never begin a trip without knowing where you are going and which route you must take to get there. And once you have reached your destination, know that you have arrived, then begin planning a new trip.

Mr. Ivey is associated with the Bertie County Schools, Windsor, North Carolina.

Industrial arts in Federal teacher training programs: status report on EPDA

Dwayne C. Gilbert

Section I. Section I of this paper gives a brief coverage of parts C and D of the Education Professions Development Act, as it was enacted in 1967. Section II deals with shifts in priorities and current status.

What is EPDA? EPDA, Education Professions Development Act, is a statement of our better understanding of how to meet the current demands of more and better-qualified people in the field of professional education. The act was structured to coordinate all Federal programs dealing with teacher education under one comprehensive plan.

Legislative authority. The Education Professions Development Program was enacted June 29, 1967, as Public Law 90-35. The Statement of Purpose, Part A, Section 501 is as follows: "The purpose of this title is to improve the quality of teaching and to help meet critical shortages of adequately trained educational personnel by (1) developing information on the actual needs of educational personnel, both present and long-range, (2) providing a broad range of highly-qualified training and retraining opportunities, responsive to changing manpower needs, (3) attracting a greater number of qualified persons into the teaching professions, (4) attracting persons who can stimulate creativity in the arts and other skills to undertake short-term or long-term assignments in education, and (5) helping to make educational personnel training programs more responsive to the needs of the schools and colleges."(1)

Different parts of the EPDA. The following chart is self-explanatory in showing the seven (7) major divisions of the Education Professions Development Act as it was originally enacted.

Part	Program Focus	Eligibility		
		State	Local	Institutions
A	Attracting and qualifying personnel	X	X	X
B_1	Teacher Corp	X	X	X
B_2	Attracting and qualifying teacher		X	
*C	Fellowships			X
*D	Training school personnel (institutes)	X	X	X
E	Training higher education personnel			X
F	Vocational education personnel	X		X

*Of special interest to industrial arts

Part C--Fellowships for teachers and related educational personnel. Sec. 521. "The Congress hereby declares it to be the policy of the United States to improve the quality of education offered by the schools of the nation by improving the quality of the education of persons who are pursuing or who plan to pursue a career in elementary and secondary education or post-secondary vocational education. The purpose of this part (part C) is to carry out this policy by awarding fellowships for graduate study at institutions of higher education and by developing or strengthening programs for the education of teachers and related educational personnel in institutions of higher education."(2)

Appropriations authorized for Part C--Sec. 528. "There are hereby authorized to be appropriated to carry out this part $40,000,000 for the fiscal year ending June 30, 1966,

$160,000,000 for the fiscal year ending June 30, 1967, $285,000,000 for the fiscal year ending June 30, 1968, $205,000,000 for the fiscal year ending June 30, 1969, and $250,000,000 for each of the succeeding fiscal years ending prior to July 1, 1971; and such sums for the two succeeding fiscal years as may be necessary to enable persons who have been awarded fellowships prior to July 1, 1971, to complete their study under the fellowships."(3)

Part D--Improving training opportunities for personnel serving in programs of educations other than higher education (institutes). Sec. 531. (a) "The Commissioner is authorized to make grants to, or contracts with, institutions of higher education and State educational agencies, and to make grants to, or contracts with, local educational agencies if, after consultation with the State educational agency, such State agency is satisfied that the program or project will be coordinated with programs carried on under part B, for carrying out programs or projects to improve the qualifications of persons who are serving or preparing to serve in educational programs in elementary and secondary schools (including preschool and adult and vocational education programs) or post-secondary vocational schools or to supervise or train persons so serving.

(b) Programs or projects under this section may include, among others, programs or projects to train or retrain teachers, or supervisors or trainers of teachers, in any subject generally taught in the schools. (Note: This has the most significance for industrial arts; others are listed in the Bill but not reprinted here.)

(c) Grants or contracts under this section may provide for use of funds received thereunder only to pay the cost of short-term or regular-session institutes; or other preservice and in-service training programs or projects designed to improve the qualification of persons entering and re-entering the field of elementary and secondary education or post-secondary vocational education, except that funds may not be used for seminars, symposia, workshops or conferences unless these are part of a continuing program of in-service or pre-service training.

(d) The Commissioner may include in the terms of any grant or contract under this section's provisions authorizing the payment, to persons participating in training programs supported under this section, of such stipends (including allowances for subsistence and other expenses for such persons and their dependents) as he may determine, which shall be consistent with prevailing practices under comparable Federally-supported programs."(4)

Appropriations authorized for Part D--Sec. 532. "There is authorized to be appropriated to carry out this part the sum of $70,000,000 for the fiscal year ending June 30, 1969, and the sum of $90,000,000 for each of the succeeding fiscal years ending prior to July 1, 1971."(5)

EPDA's contribution to industrial arts teacher training. The training of teachers came into national focus in 1958. Certain provisions were made in the National Defense Education Act to cope with the problem. However, at this date industrial arts was not included in Federally-funded teacher training programs.

In 1966, institutes in industrial arts became operative for the first time, on a very limited basis. They functioned under Title XI of the National Defense Education Act.

It was previously noted that EPDA was enacted in 1967. At this date, some of the teacher training programs of NDEA were shifted to EPDA and expanded. Short-term institutes and fellowship programs are examples.

Technically, industrial arts was a part of the "Basic Studies" programs of EPDA, but it was administered under the vocational division during 1968-69. This was of little consequence and proved to be a satisfactory arrangement. Plans were made for industrial arts programs to be administered by the Basic Studies division.

EPDA's short-lived contribution to industrial arts was the continued funding of earlier NDEA programs. During the last three years, 80 in-service industrial arts programs were conducted, in which approximately 2,000 industrial arts teachers participated.

Basic Studies Program of EPDA: "The Basic Studies Program encourages and supports projects for the training of teachers and other educational personnel who are concerned with learning more about a particular academic discipline and how to teach it in the schools. The objectives of the Program are: (1) To increase the supply of teachers in subject areas with known shortages of personnel and (2) to improve the subject matter competency of teachers."(6)

The above paragraph simply and fully explains how teacher training supported under EPDA could continue to make a profound contribution to industrial arts. Special attention needs to be called to objective number one above, with reference to Preliminary Report: Teacher Supply and Demand in Public Elementary and Secondary Schools, Fall, 1969.

According to this report: "...many school systems are encountering extreme difficulty in filling teaching positions for 1969-70 in the following assignments (most frequently listed by 47 states reporting this information): elementary school librarian, 21 states; special education, 20 states; industrial arts, 18 states...."(7)

Further reference to the critical shortage of teachers is cited under new priorities given to the EPDA program (cf. article by Marshall Schmitt, elsewhere in this volume).

Section II. Shifts in Priorities and Current Status.

Shifts in priorities. According to a recent bulletin from the United States Office of Education, the Education Professions Development Act programs have been reoriented to focus on three priorities: (1) Programs to bring new kinds of people into the schools and to demonstrate, through training, new and more effective means of utilizing educational personnel and delivering educational services; (2) Programs for training personnel in fields where critical shortage exists; and (3) Programs for training personnel to meet critical problems in the schools.

These three priorities have four distinct characteristics:

(1) EPDA represents a move away from training or retraining teachers as an end in itself to an emphasis on the child. In line with this characteristic, future EPDA projects will be evaluated on the basis of performance instead of process. The essential element in evaluation will no longer be the means by which personnel are trained, but the effectiveness of the learning that takes place as a result of that training.

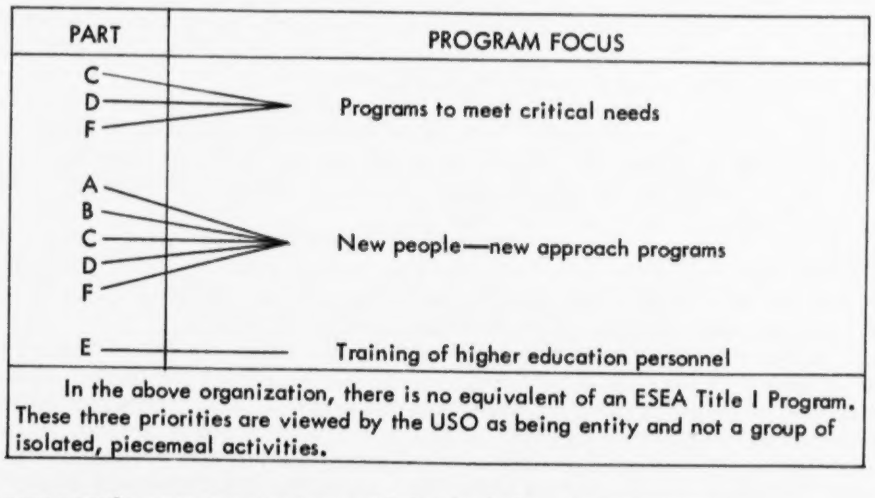
(2) Programs that focus on fields with severe manpower problems--such as early childhood education, vocational technical education, special education and pupil personnel services. (Note: Attention was called to shortage of industrial arts teachers earlier in this paper. It should be noted that this shortage is not included in item 2 above. It is recommended that proper authorities in EPDA be acquainted with this fact.)

(3) A shift is being made from primarily short-term, exclusively college-based training to an emphasis on long-term projects which involve a partnership of colleges and universities, state and local school systems and the community.

(4) Emphasize change--changing the system by which educational personnel are prepared; hopefully to eliminate the need for remedial training programs.

Overall, high priority is being placed on projects to train or retrain educational personnel who deal directly with children from low-income families.

What has emerged from the "new thinking" of the people in Washington is shown in the following chart. Each part of the original act is incorporated in the three priorities listed. (Note: Part E is administered by the Office of Education's Bureau of Higher Education.)


PART
PROGRAM FOCUS
C
D
F
Programs to meet critical needs
A
B
C
D
F
New people—new approach programs
E
Training of higher education personnel

In the above organization, there is no equivalent of an ESEA Title I Program. These three priorities are viewed by the USO as being entity and not a group of isolated, piecemeal activities.

The new people-new approaches priority includes six programs:

(1) The Career Opportunities Program: A new effort to attract and train people from low-income backgrounds into career ladder positions in poverty area schools. This will be a work-study type of training program.

(2) The Trainers of Teacher Trainers (Triple-T Program): A university-based effort to bring together the academic and education departments within the institution to work with local communities and school systems to improve the quality of those responsible

for the preparation of teacher trainers--in both institutions of higher learning and in local systems.

(3) The Teacher Corps: Will place new emphasis on stimulating lasting changes in the ways teachers are trained by institutions of higher learning and in the educational programs in schools serving children from low-income families.

(4) The State Grants Program for meeting immediate critical shortages is designed to attract new people into education; conducted primarily by local school systems. It includes programs for preparing personnel to work in: (a) correctional institutions, (b) early childhood education, (c) vocational-technical, (d) bilingual education, (e) school administration, (f) pupil personnel services, (g) educational media, (h) special education for training regular classroom personnel to deal more effectively with problems of mentally or physically handicapped children.

Two new programs are included under the critical needs priority: (1) To aid black teachers in the South, particularly those threatened with displacement through desegregation, and (2) to assist experienced teachers in urban and rural poverty area schools in raising the level of pupil achievement.

(5) The School Personnel Utilization Program: To explore a variety of differentiated staffing patterns in a few selected local school systems.

(6) The National Recruitment Effort: Presently unfunded.

Current status of EPDA in relationship to industrial arts teacher training. Parts C and D of the program seemed to have been of special interest to industrial arts teacher education. Surveys have been made that indicate both NDEA and EPDA programs in industrial arts teacher education were successful. The majority of the directors of these programs have recommended they be continued.(8)

In September, 1969, Don Davies, Associate Commissioner of Education, Bureau of Educational Personnel Development, issued a bulletin stating that the Basic Studies Program, under Part D, would not be operative during 1970 due to reduced Federal expenditure. At a later date it was learned that Part C, the Fellowship Program, had been discontinued.

The Basic Studies Program was asked to absorb eight million dollars of the reduced Federal expenditure. During the fall and winter months of 1969 and 1970, Congress hasseled with a budget for the Labor Department and the Department of Health, Education and Welfare. During this period of time, concentrated effort was made to convince Congress that the eight million dollars should be re-instated into the Basic Studies Program. Subsequently this amount of money was returned to Basic Studies. However, the United States Office of Education, by policy decision, decided to use the eight million dollars for other purposes. This action has left industrial arts teacher education without recourse.

According to the latest available information from Washington, institute and fellowship programs, as we have known them in the past, will no longer be supported by Federal grants. Our latest challenge is to look at the new priorities established by the United States Office of Education in terms of the contributions industrial arts can make in reaching national goals of education.

A fact book describing the new EPDA program will be released in the near future.

FOOTNOTES

(1) US Department of Health, Education and Welfare, Education Professions Development Act, Public Law 90-35 (Washington, DC: US Government Printing Office, 1969) 344-844/2075, p. 1.

(2) Ibid., p. 12.

(3) Ibid., p. 15.

(4) Ibid.

(5) Ibid., p. 16.

(6) US Department of Health, Education and Welfare, Education Professions Development Act Training Projects, Fellowship Programs for 1969-70 (Washington, DC: Office of Education, Bureau of Educational Personnel Development, February, 1970) p.7.

(7) National Education Association, Research Division, Preliminary Report: Teacher Supply and Demand in Public Elementary and Secondary Schools, Fall 1969 (Washington, DC, September, 1969).

(8) "Surveying the NDEA Institute," Industrial Arts and Vocational Education, April 1968, p. 24.

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Introduction to the surplus property program

E. L. Palmer

I would like to discuss the Federal Surplus Property Program from the state agency level. There are 53 state agencies for surplus property. One is located in each state and in Washington, DC, Puerto Rico and the Virgin Islands.

All state agencies for surplus property have a central distribution center. The procedure varies, but normally an eligible donee visits the distribution center and selects that property he needs, and either takes it home with him, or makes arrangements for a later pickup. Hundreds of thousands of dollars, and sometimes in excess of a million dollars in acquisition costs of property flow through each distribution center every month. Most state agencies have a large quantity of property available right now in inventory, ready for you to select. However, you cannot expect to go in tomorrow, or next week, and pick up a drill press, a pickup truck, a computer or a hardness tester that will exactly fit your requirements. It is quite possible that if you discuss your needs with the distribution center personnel, one will be available for you next month or by the time you actually need it. I can't emphasize too strongly the necessity of communicating your needs or requirements to the distribution center personnel.

We call the selection of desirable or needed surplus property "screening". All state agencies have qualified screeners who spend all, or a large portion, of their time selecting that property needed by the donee institutions in their state. Normally, screening is accomplished on the spot, where the property is located. By actually looking at the property, existing needs can be determined more accurately. If there is no need for the property in the screener's state, it is still accessed, and the information on its availability is passed on to other state agencies which might have a need.

In addition to the "on the spot"-type screening, the screeners are kept busy scanning catalogs and other listings of available property of a reportable nature. It is in these catalogs that the more sophisticated type of property is available. You can see here the necessity of communication. Our screeners have to have a varied knowledge of many types of property. Usually, the same screener is requesting medical equipment, machine tools, electronics, hardware, scientific and photographic equipment and supplies, and about every other category of which you can think. Your assistance can not only help him, but it will also help your own institution and your own program.

You might also be interested to know that many states, like Kentucky, have banded together with HEW and are screening and bringing back surplus property from Germany, England, Japan, Okinawa and other foreign countries.

Actually, all 53 states work together through, and in conjunction with, HEW, to make sure that all available surplus property is screened for the known needs of the eligible recipient donee institutions.

Most state agencies for surplus property do not receive an operation appropriation or budget allocation for expenses. Therefore, they must either wholly or in part be self-sustaining. In order to meet their operational costs, the state agencies affix a transfer or service charge to the surplus property transferred. This charge is not to be confused with a retail or wholesale price tag, because it only represents a handling charge that usually averages somewhere between 5% and 10% of the Federal government's acquisition cost when purchased new.

The state agency acts as bailee for the Federal government on the property inventoried at the distribution centers. Title passes to the donee institution when the property has been transferred to him and placed in eligible use.

Only the donee institution is eligible to receive the property. It must be needed and used by the donee recipient. An individual, as such, cannot profit by its availability.

We have 53 large and growing operations ready, capable and wanting to serve you. If you have not taken advantage of our program through your own state agency, I would suggest that you talk with your colleagues and see how their state programs have helped them.

Many young people, with the aid of surplus property and your able assistance, are finding some of the answers to some of the questions and problems facing them today in our dynamic society. Like you, we are proud to play a part in the education of our youth.

Mr. Palmer is director of the Division of Property Utilization, State Department of Education, Frankfort, Kentucky.

Securing Federal surplus property

Talmage B. Young

This presentation will deal with the securing of Federal surplus property in three aspects: (1) the advantages of the use of surplus property, (2) considerations in the purchase of property, and (3) examples of the use of property.

Advantages of the use of surplus property. Perhaps the most important advantage to be realized from the use of surplus property is in the access that can be gained to materials and equipment to broaden the base of technical activities in teaching. There are several ways in which this is made possible. To those of us who have a restricted budget (and who hasn't?) the cost ratio is a very important consideration. When we can buy with one dollar that which would cost ten if purchased through regular channels, there need be no explanation of this advantage.

The types of materials and equipment which can be secured can also broaden the technological base of our teaching. Such materials include items such as stainless steel, brass, copper, plastics and many other materials.

Examples of equipment in this category which would never be available for use because of great cost are electronic counters, precision instruments, comptometers, etc.

To add to or to develop complete new areas is also possible. Such areas include metals, ceramics, graphic arts, woods, power mechanics, electronics and experimentation. Too, it is possible to purchase parts and devices which can be converted easily to teaching aids. Often damaged instruments can be purchased by the pound or in special deals for this type of use, since operation of the device is not required in a teaching aid. In fact, prepared teaching aids themselves may sometimes be found.

Teaching equipment such as recorders and playback equipment, projectors of all types, and equipment to be used for repair and analysis in the laboratory can be secured. Perhaps it is in order to suggest that sometimes television sets, radios and so forth can be obtained free from service establishments, and that one should not ordinarily purchase this equipment from surplus unless the equipment is in good condition. Several factors are involved in the decision to purchase. These can be stated as questions to be answered as follows:

Factors to be considered in purchase of Federal surplus equipment.

(1) Will the item be used? Is it necessary, or is it just nice to have?
(2) Will the item improve the educational process and/or laboratory facilities?
(3) Is the size, age, finish, etc., in harmony with the other equipment in the laboratory – or does it produce a "mishmash" in the laboratory?
(4) Is the item complete?

(5) Is the item of equipment operable? or will repairs be necessary? What is the likely cost?
(6) Is the item a standard type of item, or is it specialized to the extent that it cannot be repaired by purchase of parts and auxiliary equipment? Is the manufacturer in business?
(7) Is the price ratio of surplus-to-new items good enough to gamble on quality or state of repair? (1:10 is often used)
(8) Can repair of the item be made a part of the educational program? or does the item have to be sent out?
(9) Is the price in keeping with the utility purchased?
(10) If not operable, can it be broken down into useful components? (i.e., power supplies, amplifiers, meters or parts for construction)
(11) Can the item be justified as stock? Will storage be a problem?
(12) Is the item justifiable under the law for your uses?

Factors to be considered in the purchase of supplies and auxiliary equipment.

(1) Will it be used?
(2) Is it of appropriate size and capacity?
(3) Can it be easily adapted?
(4) Can it be justified for education or research in your department?
(5) Will the purchase result in budgetary advantage? Is the ratio of cost to utility satisfactory?
  a. rags
  b. melting stock
  c. abrasives
  d. materials - wood, plastics, steel, paper, etc.
(6) Can the item be transformed into useful items through breakdown or adaptions?
  a. motors
  b. meters
  c. transformers
  d. mechanisms
  e. teaching aids
  f. etc.

Suggested rules for the purchaser of Federal surplus property.

Do not consider initial price in making a decision to buy. Nothing is a bargain which cannot be used.

Secure competent advice if you are not competent to judge the utility or condition of a piece of equipment before purchasing.

Try out equipment which can be connected to a source of power in the warehouse.

Make careful examinations (visual) if the item cannot be operated. Are parts such as tubes missing? Are the voltage and frequency correct for your use? Has the equipment been modified or extensively repaired?

Check for condition indicated on repair tags, etc. Remember, however, that some devices are put on surplus to remove the item from inventory, and, in some cases, the item may have been judged as irreparable in order to dispose of it or because better and newer equipment was available.

Know your merchandise. Check surplus catalogues, advertisements in trade journals and industrial catalogues. Know what you are buying and their new prices. Know sizes of equipment on hand, such as arbor sizes, capacities, belt lengths, etc., in buying supplies and auxiliary equipment.

Visit often. Know what is in the warehouses. This enables one to examine only the new.

Buy popular supplies in quantity. You cannot depend on these items' continuing in supply. Buy slow-moving items only when needed.

Play "surplus poker". Know the types of items which generally can be expected to move through the warehouses. As an example, buy a die stock and fill in sizes of dies as they appear. Buy rubber hammer heads; the hammer bodies will likely appear later.

Buy convertible items for materials, i.e., large Allen wrenches for tool steel, machine shafts for turning stock, torque wrenches for making testing equipment, brass bolts and aluminum rivets for melting, etc.

Buy for dual use. Aluminum for stock and waste for melting.

Consider modification of laboratory equipment to use certain items in large supply at a great savings. Sand belts that are slightly too long--extend the adjustment.

Anticipate "deals". Items which have been on hand for long periods may be bought in large lots at a reduced price. Boxes of tools by the pound (5¢) may be very profitable in terms of practice in tool repair as well as in the tools acquired.

Buy items which are identical - combine by using parts from one to repair others.

Sample perishable items such as photographic supplies, reproducing supplies, ozalid paper, offset materials, etc. If good, buy; if not, you do not lose.

Open paints, putty, etc., to determine condition. (This is salvage, not new merchandise.)

Examine sizes in office supplies. Paper is often smaller or larger than the size ordinarily used.

Keep special projects in mind. You may see the apparatus needed at any time. Accumulate parts, etc., for these.

Build your hardware supplies. Bolts, nuts, screws, fasteners, etc., are seldom in complete supply. Fill in as they become available.

Buy small supplies of special materials for stock.

At times furniture may be bought for use as wood for shop use.

Be sure to look under the tables. The items you are seeking may be there!

Dr. Young is on the faculty of North Carolina State University, Raleigh.

High school utilization of surplus property

Chester Lane

I represent a school system in the City of Martinsville, Virginia, that has been involved with the surplus property program since the close of World War II. We were fortunate enough to have had a superintendent who was aware and took advantage of the surplus property offered for school use. This was in 1946, and we were busy checking lists of materials offered and handling those materials shipped to schools at that time. We are using surplus property today that we secured in 1946 and have materials and tools that will be used in a new shop facility being planned. We have continued to participate in the surplus program over the years, visiting the warehouses on a regular schedule. The key to our success is the regularly-scheduled visits. Unless a school makes visits several times a year (or a month if distance is not a factor), the chances of getting anything outstanding are poor. Over a long period of time, with regular visits, your chances of success are good.

Another factor to be considered is the person who visits the warehouses or surplus yards. He should be well-acquainted with school needs in all departments, as well as with the surplus warehouses and yards. Too many schools are shortsighted in this area and suffer loss of valuable equipment because a person is sent who is not aware of what is needed or what is available.

Storage space is needed for school divisions to house property not needed immediately. This is especially true if you anticipate a building program.

Shop facilities to repair or convert materials are a great asset. We are fortunate to have a fine shop for this purpose and an excellent instructor to operate it. All our machines are completely overhauled and put into first-class condition. Much of this work is done by apprentice machinists under the guidance of the instructor.

Many of our shop facilities have been upgraded by use of materials used "as they are", converted to our use or made from parts and supplies from surplus. This applies across the entire school area - all departments and areas. We have secured in excess of $1.5 million worth of materials over the years and have spent from school funds about $1200 per year.

With surplus we have equipped a machine trade area worth over $300,000.00. As you can see, we would not have been able to have this area had we spent funds for new equipment. Many pieces now used were bought for less than .01 on the dollar. In some instances the property was an outright gift. All areas have been enriched either with "as is" use or "converted use". The beautiful part of it all is that we can afford it at surplus rates.

The feeble excuses that are heard from many quarters concerning surplus are really not valid. The real truth in many instances is that persons involved are not aware of what they see at the warehouse, don't know what to do with it when they get it or aren't willing to do the work to put it into usable condition. It is much easier to order it from a catalog and unwrap it new. We can't afford it that way.

To get the best results requires know-how, a facility to repair or convert it, personnel, and the get up and go to go.

If you haven't participated in surplus property, I hope you will get up the courage to try it. I highly recommend it.

Mr. Lane teaches in the Martinsville, Virginia, Public Schools.

teacher education

Teacher education: a multidisciplinary approach to relevance and accountability

Julius Paster

Our major theme in this discussion embraces a broad premise – "Mission Possible: Teachers for the Real World." In the context of this topic, I should like to address myself to a hypothesis: Industrial arts teacher education – a multidisciplinary approach to relevance and accountability. The development of this hypothesis, for purposes of clarity, was tempered by several observations and pertinent questions with respect to the real world of industrial arts and industrial arts teacher education, circa 1970. Of course, these observations and questions may suggest some value judgments and cardinal assumptions.

Observation I - The political, social, economic, urban, transportation, education and overall technological characteristics of our society – 1970 – are significantly distinctive from those elements which circumscribed the world of Dewey, Kilpatrick, Richards, Bonser, Bennett and Snedden.

Question: (A) How far has industrial arts education travelled toward the attainment of those philosophical pronouncements that were substantively stated by those educational leaders during the early decades of this century?

(B) As we move into the last third of this century, what are those unique features of industrial arts education (and industrial arts teacher education) programs that distinguish the present from the past?

Observation II - There is much clamor for legislation and additional Federal support funding for industrial arts.

Question: (A) Will new laboratory facilities or hardware provide the stimulus for educational and professional renewal in the innovative society that provides testimony to the beneficent and baneful consequences of technology?

(B) To what extent can legislation provide the empathy, dedication and those human/intellectual qualities so necessary for teachers – particularly those in the inner city, Appalachia or the rural South?

Observation III - Many teachers and programs in industrial arts teacher education have been insulated from interaction with: (a) each other; (b) other disciplines; (c) contemporary technology; (d) students; (e) the community; (f) and, in particular, the real problems of the public schools.

Question: (A) With respect to an intellectual premise (a goal that always existed but is infrequently attained in industrial arts programs), has irrelevance flourished because accountability or criteria have been minimal, superficial or nonexistent?

(B) To what degree has public education, with many-faceted problems, patronized the presence and existence of industrial arts regardless of what was or is going on in the laboratory or shop?

Observation IV - In several sectors of the nation, those directing public school industrial arts programs have been primarily interested in recruitment of teachers (regardless of capability) rather than in refinement of content, process and community involvement that serve to promote dynamic educational experiences.

Question (A) Is there evidence of nullifying characteristics in present programs that tend to discourage young people from pursuing, by elective choice, industrial arts courses on the secondary level or that perhaps deter their interest in industrial arts teacher education?

(B) Will current expediencies in recruitment and staffing serve to enhance or undermine the professional-public images and student perceptions of industrial arts education and industrial arts teacher education?

Observation V - There are many technologically-related problems (environmental, educational, social, economic) that have besieged our society. A number among us proclaim that humanistic and social/cultural relationships should provide the substantive base for the study of technology, either as a distinct discipline or as the important component of industrial arts programs.

Question (A) When we examine curriculum goals for all disciplines in public education, do we not find broad reference to humanistic and social/cultural values?

(B) Is it possible to teach humanistic and social/cultural relationships? Or, are these phenomena the outgrowth of worthy learning experiences?

(C) What are those characteristics that may identify the uniqueness of technology, past and present, in industrial arts programs?

In looking about the profession, I sometimes wonder whether we are pursuing the path of romantic regression. A recent publication featured a 1970 sequel to the pump lamp – in the design of a chianti bottle lamp. In the northeast, a new professional industrial arts association has elicited membership by promoting a yearbook of project ideas. Typical practices in industrial arts teacher education programs pursue a craft orientation coupled with professional preparation that is trade analysis-oriented, stereotyped and very pedantic.

These, I believe, are tangible evidences of irrelevancies of the past that are nullifying the present – and most definitely they are factors that are damning or dimming the future. With respect to teacher education, far too frequently teacher educators have expounded the future, reveled in the present – and have exemplified *modi operandi* of the past. Many industrial arts teacher education programs throughout the country are being subjected to cost, credit and benefit factor studies by administrative officers. What criteria might you employ in defending the continuation of a program for the next five, ten, twenty or thirty years?

At this convention where we meet to promote our professional and personal fellowship, it is not my intent to underestimate our virtues or overstate our faults. Rather, I am suggesting some soul searching toward an intellectual review of static curriculum patterns. We can explore the past to help find relevance for the present. But more significantly, as we approach the twenty-first century, the renewal of our profession will be contingent upon the attainment of the following tenet:

> Industrial arts teachers of the future will be comprised of those men and women (regardless of ethnic or racial backgrounds) whose knowledge of society, and of the role of technology in society, will at least equal their respective professional and technical competencies toward promoting relevant education for all children.

Within the context of the aforesaid contemplations, I should like to propose a new approach – a model for a multidisciplinary industrial arts teacher education program. With appropriate adaptations, this model may provide a new orientation for industrial arts programs, in the secondary schools. At the moment this model, as stated at the outset of my presentation, is a hypothesis. Implementation, time and experience, as an experimental pilot program, may well determine credibility in comparison with the traditional approaches in industrial arts teacher education. For your reference, a self-descriptive illustration of the proposed model is appended to this paper.

Scope and unique characteristics:

(1) Emphasis upon a firm cultural base in the humanities, social sciences and natural sciences.

(2) The inclusion of multidisciplinary seminars to promote wider integration of the cultural and technological elements in teacher education. Typical seminars that may be included: (a) Technology and Man; (b) Technology and the Community; (c) Technology and the Environment; (d) Cybernetics; (e) The Computer in our Life; and (f) Psychological Implications of Automation.

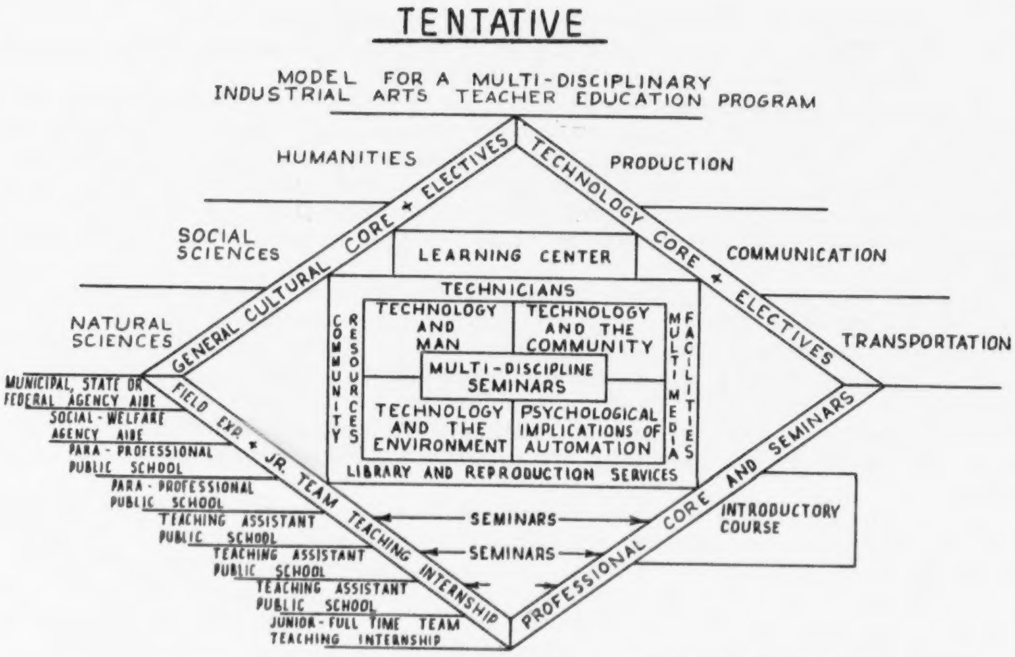
(3) Field experiences, junior team-teaching internships and seminars will provide the thrust in professional preparation by bridging educational theory and teaching practice toward promoting meaningful interaction between the college, public schools and the community.

(4) Provision for a learning center facility that will provide necessary instructional resources for all disciplines and will serve as the coordinating unit for professional orientation and kindred field work activities.

(5) To enhance and correlate problem solving and functional learnings in the technology areas of communication, production and transportation, the following approaches will provide new directions toward the attainment of positive educational responses: (a) Team teaching; (b) Field visitations and use of community resources; (c) Integrated laboratory experiences; (d) Use of varied instructional media; and (e) Employment of para-professionals.

(6) College credit may be granted for technical work experience.

(7) Special curriculum considerations (e.g., ethnic studies, conversational fluency in a foreign language) will determine programs of study for those prospective teachers who


TENTATIVE
MODEL FOR A MULTI-DISCIPLINARY
INDUSTRIAL ARTS TEACHER EDUCATION PROGRAM
HUMANITIES
SOCIAL SCIENCES
NATURAL SCIENCES
PRODUCTION
COMMUNICATION
TRANSPORTATION
GENERAL CULTURAL CORE + ELECTIVES
TECHNOLOGY CORE + ELECTIVES
PROFESSIONAL CORE AND SEMINARS
FIELD EXP. + JR. TEAM TEACHING INTERNSHIP
LEARNING CENTER
TECHNICIANS
TECHNOLOGY AND MAN
TECHNOLOGY AND THE COMMUNITY
MULTI-DISCIPLINE SEMINARS
TECHNOLOGY AND THE ENVIRONMENT
PSYCHOLOGICAL IMPLICATIONS OF AUTOMATION
COMMUNITY
RESOURCES
MULTI MEDIA
FACILITIES
LIBRARY AND REPRODUCTION SERVICES
SEMINARS
SEMINARS
INTRODUCTORY COURSE
MUNICIPAL, STATE OR FEDERAL AGENCY AIDE
SOCIAL-WELFARE AGENCY AIDE
PARA-PROFESSIONAL PUBLIC SCHOOL
PARA-PROFESSIONAL PUBLIC SCHOOL
TEACHING ASSISTANT PUBLIC SCHOOL
TEACHING ASSISTANT PUBLIC SCHOOL
TEACHING ASSISTANT PUBLIC SCHOOL
JUNIOR-FULL TIME TEAM TEACHING INTERNSHIP

JULIUS PASTER
FEBRUARY 1970

may teach in the inner city.

(8) The technical area of communication will include course work in computer science/mathematics, programming and data processing.

(9) Ample opportunity will be provided for electives in the cultural, technical and professional areas.

(10) The model suggests broader dialogue and interaction between industrial arts educators and other members of a university, college or school faculty.

(11) The model provides for a greater degree of involvement by students with human and societal concerns.

(12) Industrial arts teacher educators could utilize the public schools (rather than university classrooms) to demonstrate the what, how, where and when of curriculum content.

(13) The model suggests a greater degree of technological adaptability for the student.

(14) The model proposes greater diversity in the integration of theory and practice.

(15) The model supports a sense of realism and dynamism for a technology-oriented industrial arts teacher education program.

(16) The model presupposes a greater degree of student, faculty, college, public school and community involvements; hence, a greater degree of internal and external accountability may provide the stimuli for ongoing evaluation toward the improvement of curricula, learning and teaching.

Dr. Paster is on the faculty of The City College of The City University of New York in New York City.

A teacher for tomorrow

Iver H. Johnson

The strides taken in recent years by science and technology have presented our society with problems never before imagined. Other problem sources could readily be listed. Regardless of the source, solutions must be sought in all societal institutions. This, naturally, includes our educational institutions. Far too many of our youth, of all levels of intelligence, are leaving school before they graduate. Even more are tuning out as early as the third or fourth grade. This, in essence, suggests that these children are "dropping out" and "tuning out" because the school is not providing the challenge of our society today. Learning is not exciting, active and interesting. In reality much is passive, dull and lacking in intellectual challenge. Teachers are teaching much of what they were taught as it was taught to them. If the teacher was forced to memorize vast amounts of questionable material, it is logical to assume that his students will be engaged in similar activity. If he made a cutting board, his students are probably making cutting boards. The story seems endless, regardless of the subject being studied. Far too few teachers emerge from this comfortable psychological trap.

This being the case, we can only conclude that a significant change in teacher education is in order. There is a distinct need in our present and future society for a new kind of teacher. If we are willing to accept this initial assumption as having a valid basis, we have stated a problem. Problems require solution. That which follows is but a theoretical base for a solution. Our conclusions are the result of study, observation, intuition and experience.

The feedback we appear to be getting from our present society suggests that education is not producing a product essential to the ultimate welfare of that society. The teacher we need in education today is one who has learned how to learn. Hopefully we can develop a product who is creative, has an inquiring mind and a thirst for action-oriented knowledge. He is able to identify problems and enthusiastically engages in heuristic problem-solving activity. He must also know himself (self-identity), know what he is doing (self-orientation) and where he is going (self-direction). He has come to realize the value of commitment, and is able to commit himself. This, in summary form, is the kind of individual needed in education today. Sadly, there is a distinct lack of people of this type graduating from our colleges today.

How many of us engaged in teacher education are now rationalizing this failure on our part with statements such as those which follow: "We don't get people like that in our courses." "The students today aren't interested in any of the things you are talking about." "Our present products are good enough and doing a fine job." Many others could be phrased, but why be redundant? We can accept the status quo or seek better goals and means to achieve these goals.

How does an individual come to be a self-assured and creative problem-solver? The key word here is the individual. Our present system does not treat a person as an individual. The present ecology of education is teacher-centered, group-oriented and textbook based. It is difficult if not impossible to emerge from this context. Let's attempt to change the ecology of education as we know it today. We can make our programs learner-centered with emphasis on the learner rather than on the teacher. Let's change from a group orientation to an individual orientation, using a process approach to learning. The textbook is narrow and restrictive. Why can't we "tune-in" to a real life, real action and real environment base? In far too many situations we have taught things the students already know, we taught things they were not prepared or did not care to learn and, in essence, we tend to develop habits of conformity. If conformity is our goal then we are justified in what we have done and are doing. If the total personal development of the individual is a goal, then we must take a fresh look at our approach to educating teachers.

We have suggested a learner-centered curriculum. The term needs clarification. A learner-centered curriculum must be individualized. It must also be personalized. The teacher and learner together plan the learner's program in full consideration of the learner's entry-level behaviors and already-acquired skills. Much of the information he will learn can be developed for inclusion into instructional packages. His learning pace becomes his own, and evaluation can take the form of performance-oriented behavioral objectives. A learning resource and research center is implied when learning takes place in this vein of thought. The instructional materials must be very carefully developed to stimulate and motivate the individual to personal achievement.

We have also suggested process-oriented learning. This, too, needs clarification. Process as mentioned refers to intellectual processes. These might include hypothesis formulation, abstracting, translating, simulating, sequencing, predicting, inferring, analyzing, synthesizing and others. Here could lie the answer to many of our past failures. How many of us have consciously attempted to involve our students in the more sophisticated thought processes? Really, haven't we been more concerned with the cognitive knowledge level of learning? This has been referred to as "vessel filling" and, while it seems to serve an immediate purpose, we can seriously question the amount of material the student has actually internalized. Our information suggests that only when learning is internalized does it actually have any degree of permanence. A process approach to learning is essential if we hope to develop a problem-solver. An individual cannot begin to see himself unless he has internalized his learning to the point where he is willing to make a philosophical commitment.

A third position suggested that we change the learning environment to one of life action environmental orientation. The classroom does not truly teach the problem of the ghetto, of educational encounter, of political encounter or environmental pollution. To develop the individual discussed earlier requires some on-site involvement on his part from the beginning of his collegiate education. We must send him, or, if this is not practical, bring to him the truth and beauty of his environment. We must devise a seminar condition which encourages engagement with the problems of society. We can no longer think that as a discipline we are an empire unto ourselves. Others have much to contribute our way, and hopefully we will develop a teacher who has much to offer to others.

In review, we have indicated the need for some reconstruction in our teacher education programs. We are advocating the central importance of the individual. This proposal suggests that our programs become learner-centered, process-oriented, with a life action base. All of this becomes necessary to bring forth an individual who is problem-oriented and aware of societal needs. Can we evolve from the days of the birdhouse, to the individual problems, to the social and technological problem or something even greater? Aren't we obligated to try?

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Teacher preparation: training or education

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In our many meetings with teacher educators and others honestly interested in our educational system, and with the vast amount of research and reading done in the areas of teacher preparation, we believe that few if indeed any of those involved in the teacher preparation process really perceive a difference between teacher education and teacher training.

Looking at the literature dealing with the educational profession, one finds that the terms "education" and "training" are interchanged freely within the context of any given article. The dictionary of educational terms plus research guides in education consider the two terms to be synonymous. However, a careful review of educational literature and the attempt to clearly define those two terms suggest a distinct difference.

The dictionary defines education as "to develop and cultivate mentally", but to educate also elicits such statements as: giving meaning and insight, or the application of information with deep understanding. Training suggests, according to the dictionary once again, "to form by instruction, discipline, drill, etc.... to educate narrowly." It is a process of helping others to acquire skills without reference to any great meaning. The needs of training are immediate, the goal short-range.

We would like to suggest that there is a basic and fundamental difference between teacher education and teacher training, that teacher education should connote a process and a result quite different from that of teacher training.

To suggest that teachers should be trained rather than educated is to suggest that we can predict quite explicitly a number of very important variables, such as, the type of school in which our student teachers will teach, the material they will need to know to do that teaching and the type of student with which they will be working. We question the predictability of these variables in a rapidly-changing and increasingly-mobile society.

Teacher preparation then must move beyond the realm of teacher training into that of teacher education. Teacher educators must be prepared to respond to the yet unknown, to the enormous variety of changes in society and in our schools, for new organizational structures, new staffing arrangements and new curriculum development, as well as to the tremendous impact of advanced technology, plus increased student-centered approaches with its concerns on humanism and affective learning. If, for example, 75% of all basic educational skills could be taught through computer-assisted instruction or other automated media, present-day teacher training institutions would be forced into major change. The future teacher, then, rather than being trained to teach skills to the majority of students, would be concerned with working with students in those areas that computer-assisted instruction could not reach. This would require the teacher to work with students in areas not yet conceived of as part of the curriculum.

In essence, we feel that teacher educators cannot continue to train teachers for today's schools when these schools will be fundamentally different in the future. And those teachers could very well be teaching beyond the year 2001.

The ultimate effort of teacher education, then, should be truly to educate teachers, to prepare teachers to be flexible, creative and innovative, to be able to improvise and operate confidently within the context of independence and rapid change, and to be extremely sensitive to the needs of students who will be viewing teachers increasingly more as facilitators of learning than as purveyors of knowledge.

The realization of a distinct difference between teacher training and teacher education is perhaps the initial step to changing existing pre-service teacher preparation programs. There are, however, two basic reasons why the change to teacher education will be difficult to accomplish: 1) the most obvious and most critical is that the people now in charge of teacher training are simply unwilling to make changes which will threaten their own sanctified traditions; and 2) reinforcing this traditionalism is the self-righteous assumption that our schools are accomplishing those ideals and goals that we have set for ourselves.

One should begin to realize that teachers and student teachers who are trained are simply not interested in what they are doing because they are told what to teach, where to teach, when to teach and how to teach in the same manner that an industrial production line worker is trained to do his job.

Our criticism, then, is of teacher training and of the concepts it conserves and transmits. The students who endure it come out as passive, dogmatic, intolerant, authoritarian, inflexible, conservative personalities, who desperately need to resist change in an effort to keep their illusion of certainty intact.

It is difficult for us to imagine any educator or any educational institution less able to help students to be able to meet the needs of a drastically changing future than one which fosters the development of concepts and attitudes such as those just mentioned.

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Man-Society-Technology-Change / Industrial arts teacher education-Change

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We are moving into a new decade. Many people around us claim that this will be a time of love and understanding. Almost as many people claim that we are doomed to a tragic and violent end. The present tempo of change seems to support both viewpoints.

Our convention theme appears to be dealing with the change interplay and interrelations of Man - Society - Technology.

It is my contention that Man, Society, Technology are not equal in terms of influence on change. I would like to indicate briefly the extent of change in each, and how the influence of each upon the others has changed.

Actual change in Man has been primarily physical. The systems of the human body haven't changed much from the Judeo-Christian times, or Adam and Eve, or the scientific "missing link" theory of the primates. We still have the bones, brains, organs and vessels of our ancestors. The size of parts and the whole system have changed. We are larger (height and weight); parts of our bone structure are larger or smaller; several of our organs are larger or smaller; and our strength and longevity have increased.

It is true that the cultural changes in Man have been vast and varied – the culture and the Man are different. Changes in Man have been physical.

The most significant change in Society has been population growth. Changes in population have caused societies to rise, fall, remain in one location, become wanderers, grow in influence or decay into oblivion. The culture of society is most greatly affected by population. If a society is small, it can exist in balance with nature. If a society is large, it must become inventive and ingenious to survive.

This brings us to our third variable – Technology. The rate of change in Technology during the past century has been nothing short of phenomenal. It seems that technology breeds itself and that its gestation period decreases with each embryonic implantation into the scientific womb.

Technology is presently being blamed for the ills of advanced cultures. It is the tools of a culture, the application of the concepts that scientific discovery has unearthed. It has been used to free man from meaningless toil at the expense of man's environment.

The most fantastic changes in technology have been in power and communication. Everything else has developed either directly or indirectly as a result of change in these two categories.

In the very beginning Society and Technology were functions of Man. All changes in them were dependent on the decisions of Man the Individual. Man completely controlled his tools (the Technology) and his family (the Society). We in contemporary civilization call this Man primitive. He lacked an effective means of communication. He was unable to affect his physical environment significantly. He lived without knowing answers to the great questions of life.

Man survived and his numbers grew. As his numbers grew, Man found that his individual influence was diminishing. His leadership was challenged. His wisdom was questioned. Man sought the advice of other men. He discovered that not all of his decisions affected all of the people positively. Now decisions had to be made in terms of "group" needs. Society became the dominant force in civilization.

Groups and sub-groups began to function. The struggle for survival became a function of the society. Man was most secure as a member of Society. He was much less secure as an individual.

Society survived and its numbers grew. As the growth continued, so did the search for answers to the "questions of life". Small groups of men controlled large groups of men by knowing some of the answers. The more efficient the tool- and knowledge-users became, the more influential they were.

Thus Technology shows its influence. Both Man and Society work extra hard to develop tools and knowledge that will expand their influence. They find that the more technology they control, the more civilization they control. We are presently in time when we look to see how the expanding Technology will affect Man and Society.

The development of industrial arts teacher education in the United States has been brief. Only a century has elapsed since its earliest recognizable forms. This evolution has not been filled with earth-shattering or high-impact developments. Nor has it been filled with profession-wrecking setbacks. We have moved from no industrial arts teacher education programs in 1850 to well over 100 in 1970. Some universities even offer graduate programs leading to the doctorate. Before this century there were no industrial arts programs in the public schools. Now over 75% of secondary schools have some form of industrial arts.

Some critics, especially those within our own ranks, condemn us for not keeping pace with technology. Nothing in our society has kept pace with technology. Even industry is floundering in its newfound powers. Teacher education has adapted and innovated as well as any other segment of our society.

Let me explain. As industry has changed tools, materials and processes, so have we changed our teaching. Many things in industry have not changed drastically – and, likewise, we haven't changed. For example, consider the changes in tools. The big change in hand tools has been the addition of portable power – we have adapted to this change. Now consider changes in materials. Except for the very exotic materials, we are involved with learning experience with a variety of materials. Lastly, the processes area. Here is where we take an undue amount of abuse. We are criticized because we still encourage individual learning experiences. An individual student is encouraged to subject various materials to various processes with various tools – and for this we are criticized. Has overpopulation become so vast a problem that everything must be done in groups or committees?

Most teachers were educated with learning experiences in three broad categories: liberal arts and sciences, professional-technical and professional-educational.

Criticism of the liberal arts would add very little fuel to the liberal studies inferno. The other two categories are most worthy of our discussion.

In the professional-educational category, we have had these kinds of learning experiences: history and philosophy of education, psychology, methods of teaching and some form of field experience. The exact nature, number and arrangement of specific causes varies from institution to institution. Most can be separated into these four groups.

Now then, the category of professional-technical. It is in this area that we give the prospective industrial arts teacher learning experiences with technology and industry. At the turn of the century, broad course offerings in the technical category read like this: woodworking, metalworking, arts and crafts, and drawing. Again, specific courses varied within each area.

In reality, major changes in this category have been slight. Only a very few programs have changed or innovated in our professional-technical learning experiences. Generally, the arts and crafts have been dropped for specific technical areas such as plastics, ceramics, electronics and others. Our students concentrate their technical studies in exotic areas such as forest products technology, aerospace technology or communications technology. We are still concentrating very heavily on specific technical skills.

A few of the innovative programs are showing us the way. Previously, I mentioned forest products technology, communications technology and aerospace technology. These are starting in the right direction. Teacher education is beginning to phase out specific materials and processes areas. These are coming together in composite courses. We are looking back to our colleagues in other subject areas to help with this integration. During this decade of the seventies, teacher education will make significant strides in changing its programs.

There is at least one challenge that we have not begun to meet significantly. We (teacher educators) have centered our energy and interest on producing competent industrial arts majors to work in the public schools. These men have been ill-prepared to teach at all levels of the public school. We must open our doors to other subject areas. If the goals of industrial arts are ever to be reached, then our subject must integrate with the others. An elementary education major must be exposed to learning experiences with automation and power. We must open, expand and interweave our subject area if we are to survive to fulfill our mission.

In summary: Changes in man have been physical; changes in society have been in population; and changes in technology have been in communication and power. The influence of each upon the other has shifted emphasis. Today, technology exerts the strongest influence. Innovation and change in industrial arts teacher education have been consistent with the pace of society. Presently, innovation is occurring in the integration of our subject area with all other subject areas and grade levels.

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The professional semester—teacher education center concept

Stanley E. Brooks and Langdon Plumer

Introduction. For the past two years the Industrial Arts Education Division, at Buffalo (NY) State University College, has been developing a teacher education program which focuses upon a true integration of theory and practice within the professional education component. Due to a preponderance of junior college transfer students, the professional education sequence begins in the junior year with educational psychology, followed by a professional education course – Introduction to Industrial Arts Education – which is followed immediately by the Professional Semester Internship. The careful arrangement of purposeful teacher preparation experiences, in each of these three courses, has provided the teacher trainee with a significant in-depth preparation, which is a vast improvement over the typical methods-student teaching program, a program which feasts on campus-oriented methods and theory courses, taught by campus-bound professors, who because of seniority don't supervise student teachers because "that is for you younger fellas"... and a student teaching assignment which "puts" the student "out there" in the public schools and considers one or two isolated visits to be all that is needed.

But enough of the disease... let's look at how this tremendous educational gap of theory and practice has been fused into an exciting, realistic opportunity for young folks to become "students of teaching".

Pre-internship professional experiences. Education for the preparation of professional teachers is a process of living; therefore, actual experience with children in the classroom and in the community provides the trainee the best opportunity to test and refine his philosophy of education, his effective techniques of teaching and his skill to plan for and direct the growth of children. This is begun when the college student enrolls in his educational psychology course and begins to study basic learning theory and its application in the classroom. Observation in the public schools, coupled with an opportunity to develop individual pupil profiles, sets the stage for the more in-depth observation and participation experiences which are a part of the second course – Introduction to Industrial Arts Education.

It is within this second course that notable changes have taken place, since most of the activity is directed towards the fulfillment experience in the Professional Semester.

Initial emphasis in Introduction to Industrial Arts Education is directed towards a clear identification of the field of industrial arts and the subject matter therein. So often what appears on the surface to be comparatively simple and rather obvious actually is found, upon close examination, to be intricate and complicated. Such is the case with teaching and the gaining of an understanding of the place and function of industrial arts in American education.

A second purpose of the course is to acquaint the student with the procedure for organizing to teach industrial arts. This is effected through a series of structured observation and participation meetings at the public school and with the supervising teacher with whom the student will intern during the next semester. Through this planned observation and participation, the student will be developing a short instructional unit with the cooperative guidance of his future supervisor and his college professor. This unit will be taught early in the Professional Semester Experience. It should be noted that the college professor may well be the intern's college supervisor (resident supervisor of teacher education) during the Professional Semester. It is felt that this integrated approach gives new meaning to the typically fictitious instructional planning which is often a mechanistic exercise in the methods course.

Further acquaintance with the profession of teaching is gained through the use of video-taped, audio-taped and written simulation materials. These learning modules pose realistic situations in teaching, staff relations, parent-teacher relations, teacher-administrator relations and teacher-community relations.

Another significant improvement in the pre-internship course is the introduction of the Parson's Guided Self-Analysis Evaluation System (GSA). Early emphasis is upon learning the coding skills, and these are presented with video tapes, audio tapes and typescripts. During the Professional Semester each intern will execute one GSA evaluation per week, so he must learn the coding skills prior to his internship.

The prime thrust of the experiences in Introduction to Industrial Arts Education is centered on directed planning for an involvement in the specific classroom and laboratory learning environment where the student will intern during the Professional Semester. He learns to plan for the "real teaching-learning problems" as faced by "real teachers in the real school setting."

Upon satisfactory completion of the pre-internship course, as measured by selected evaluative performance criteria, the student enters his Professional Semester Internship. He is now a member of a group of twelve interns who are located in a Teacher Education Center.

The Teacher Education Center and its personnel. The total professional program is supported by the belief that the public school personnel have been for too long "apart from" rather than "a part of" the teacher education program. Seldom have our partners, the public school personnel, been involved in any way, other than to receive, house and discharge our constant stream of student teachers. And to make it worse, our irregular-haphazard visitations haven't added much "class" to the total package.

The Teacher Education Centers are developed with the realization that the public schools want to assume a greater role in teacher education and so, as meetings are held with administrators in the local schools, the college staff has found in the public school people a sincere willingness to cooperate fully... in fact an excited willingness, as they see their responsibilities being encouraged by the college.

The Center is a group of junior and/or senior high schools clustered in a geographically close-knit area where twelve interns can be housed with twelve jointly-selected industrial arts teachers. Since this approach places some responsibility on the public schools to aid in the program, it is expected that one of the schools forming a Center will provide a small classroom that can be a permanent home base for the interns and where the majority of intern discussion sessions can be held. Of the four Centers currently in operation, the home base classroom is available in only two centers. In one of the centers, Urban Buffalo, the interns return to the college campus, and in the other center, the six schools involved have made available conference rooms or small classrooms on a rotational basis. This writer views the latter two settings as temporary measures.

As an amoeba changes its shape, so can the arrangement of schools within the cluster; however, it must be remembered that this program seeks the best possible men for supervising teachers, and these men and their instructional programs are of prime concern when establishing a Teacher Education Center. Every attempt is made to use schools where two interns can be placed with two supervising teachers in one school, so normally a Teacher Education Center would consist of a maximum of six junior and/or senior high schools. The reason for two interns in a school is to support another belief which rests upon the idea that peer evaluation and counsel are significant factors in an intern's internalization of success.

Frequent seminar discussion sessions are held at the home base classroom and, on selected occasions, are held at the other schools in the Cluster. Topics for discussion often center on the same themes as did the outmoded methods class on campus, but now the readings, worksheets, unit and lesson plans, sociograms, video-tape analyses, etc., take on a relevance worthy of intense study, for these are today's and tomorrow's problems for each intern.

With twelve interns representing a full teaching load for the college industrial arts supervisor (hereafter referred to as the Resident Supervisor of Teacher Education), he is now able to assume a significantly different role, than in the old setting. As many of you know, the "old setting" consisted of three or maybe four visits during each nine-week period. Now that the intern is in the same environment for the entire semester, and since the Resident Supervisor of Teacher Education's schools are geographically adjacent, a far more professionally intimate relationship is developed. The Resident Supervisor of Teacher Education will be in contact with each intern and supervising teacher several times each week. This means that all persons concerned must be willing to work together on the common problems and opportunities which arise in the "real school setting". Thus, the Professional Semester enriches the individual intern's experiences, and also personalizes those experiences.

The Resident Supervisor of Teacher Education finds himself being called upon frequently to serve "his schools" in the capacity of educational consultant. Because of the close relationship now being developed between the public school administrator, supervising teacher and Resident Supervisor of Teacher Education, the college representative is now a more effective partner in shaping instructional improvement in the public schools.

The supervising teacher becomes a changed figure, too, for now he is involved in the actual preparation of the interns through his leadership in handling selected portions of the instructional content. Yes, he teaches and leads some of the discussions, as do the superintendent, principal, A-V coordinator, guidance personnel, custodians and others. They all become involved in our joint partnership to improve teacher education.

The public school supervising teachers have the opportunity to take a tuition-free graduate course designed especially to aid them in becoming more successful supervisors. The course, "Supervision of Industrial Arts Student Teachers", was instituted three years ago and has served many of the area's supervising teachers. This course was actually taught in the first Teacher Education Center during the school day, where the supervisors, on a released-time basis, attended the graduate class while the interns taught their supervisors' industrial arts classes. The supervising teachers received three semester hours of graduate credit, but more important to the success of the Professional Semester concept, were the many discussions which ensued throughout this course, adding much to the planning for the second group of students who were to be engaged in the Professional Semester.

The Professional Semester. This will be the future industrial arts teacher's culminating professional experience at the undergraduate level. It is an integrated series of developmental experiences which are designed to include a broad range of professional opportunities in preparation for full-time professional employment.

Because the intern has already spent considerable time in this school and with his supervising teacher, as a part of the Observation-Participation in the Pre-Internship Course, the usual induction time to the school is reduced. The intern will know the principal and a few of the staff. He will probably know a number of the students' names, he will be acquainted with the facilities and much of the program ... in other words he comes with considerable knowledge about the Professional Semester setting.

Furthermore he comes prepared to teach the short unit which he planned with his supervising teacher and his college professor in the Pre-Internship Course. And hopefully the intern will be teaching "his unit" in the first two or three weeks of his internship. Use of video-tape equipment will be used during the intern's teaching, and, at the conclusion of various segments of his teaching, the intern will code and plot his teaching profiles using the Guided Self-Analysis System. The GSA system will continue to be used by the intern throughout the Professional Semester Experience.

During the third week each intern will meet with his building principal to discuss an assignment to work with another teacher in some on-going phase of the co-curricular program. This could include junior varsity sports, honor society, Spanish Club, choral music, etc., but the intern must become directly involved. Already several of the interns have made notable contributions to the school's work through these co-curricular associations, and have strengthened their own understanding of the co-curricular program. The intern has also gained skill in working with children and youth in a different educational setting.

Course of study development will continue to be a central theme for the discussions of the resident supervisor of teacher education, the supervising teacher and the intern. Each intern is expected to plan and execute an extended period of self-designed instruction; either a unit of three to four weeks' duration or two shorter units of instruction. The intern should be engaged in teaching the unit by the 10th to 12th week of the Professional Semester. He is responsible for all planning, preparation, media development and evaluation for his instruction.

The intern has occasion to assume a new role when he serves as a peer leader for the pre-intern student, who makes his periodic observation-participation visits, to the intern's "laboratory". It is assumed that some nominal attempt at a team approach could evolve from this group... participator, intern and supervising teacher.

Along with the foregoing experiences the intern will be involved in sharing responsibility for the daily instructional program. Also he is expected to participate in professional and related activities; i.e., staff meetings, PTA, open house, adult education, departmental curriculum projects, etc. In other words the intern is to get a total immersion into the world of the professional teacher.

Program evaluation. At this point there are some readers who will be saying, "How do you know this approach is any better than your previous program structure?" And, of course, this is a question which needs some attention. The Professional Semester didn't become the current pattern just because of its "frills and color".

In the pilot stage of development of the Professional Semester, The Division was continuing its regular student teaching sequence of educational psychology, methods, student teaching and a final post-student-teaching methods course. The first two groups of Professional Semester students, who would get their methods on the job and would not have the pre- or post-methods classes, were given the same mid-term and final examinations as were administered in the two methods classes on campus. The Professional Semester students performed better on the first methods test, and as well on the post-student-teaching methods test, as did their peers who were getting the six additional semester hours of methods credit. This information alone caused the primary investigator to be somewhat assured that the Professional Semester was meeting its content responsibilities.

But that wasn't enough to warrant a total program change, and so informational discussion sessions were held between regular student teachers and the interns, and they were asked to respond to a 56-item inventory to assess the degree to which students, in each of three different groups, had the opportunity to experience the many facets of teaching and professional growth. Again, the Professional Semester Interns had greater opportunity to intensify and internalize the experiences than did the other two groups.

The next step was to seek the observations of the supervising teachers, and here it was found that the opinion was split. Those who saw value in the concentrated college-school efforts really supported the concept shift, but there were some who felt insecure in the change-over and were quite solidly opposed. This was a vital bit of information, and, in recent Center development, considerable effort has been directed to a better orientation program for the supervising teachers.

Probably the best index of program success is: "Are the graduates of the Professional Semester successful in public school teaching?" Thus far the follow-up studies indicate that each man is performing at a level in excess of that typically demonstrated by a first-year teacher. Their principals also noted a better adjustment to total staff responsibilities and a greater sense of security in coping with the on-going instructional program.

Beginning in the Fall Semester of 1970, The Industrial Arts Education Division will cycle into the Professional Semester Concept for all students. In numbers this means six to seven Teacher Education Centers will be in operation each semester, for some 72 to 84 interns and requiring the full-time services of six or seven Resident Supervisors of Teacher Education. This idea is past the experimentation stage... it is The Program.

And finally. If there is a special or unique aspect to this approach, the writers believe that it is the fact that we have been in constant touch with each student teacher's growth on a daily basis. Typically, the student teacher receives a visit every two weeks or so - a command performance. But this isn't the reality of teaching, and it isn't the best way to promote the orientation and growth of your men into the teaching profession. Furthermore we have been in daily contact with our supervisors and through their wise counsel have conditioned our "perfect plans" to the reality of the classroom and real children, a lesson we would like to share with other colleagues.

But most important is the idea that the Professional Semester has been a joint educational venture between forward-looking school systems, their dedicated staffs and a teacher education institution that wants to go beyond the traditional limits of maintaining "what has been". It is not the ultimate answer to our vexing problem of "how best to prepare tomorrow's teacher"... but it has taken us toward a new dimension in our thinking and our planning in teacher education.

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The manufacturing technical semester at Buffalo State University College

Jack C. Brueckman, Jr.

A new course has been instituted as part of the industrial arts teacher education program at Buffalo State University College. This course, called the Manufacturing Technical Semester, couples an eight-week industrial internship with an additional eight-week, on-campus, curriculum development study.

The technical semester is a fifteen-semester-hours credit elective course in the junior or senior year and is an integral part of the curriculum of liberal arts, technical and professional subjects which the college student selects as part of his total program. Prior to the technical semester, the student has completed technical courses in the areas of ceramics technology, forest products, metal technology and plastic technology. The students select the technical semester in lieu of advanced technical courses in the field of manufacturing.

As a future teacher of industrial arts courses in a technological society, the college student should be prepared to develop in his students an understanding of the modern industrial complex and its operation through meaningful laboratory experiences. It was this thought of technological literacy for today's youth that helped to foster the idea of cooperation between education and industry in the preparation of industrial arts teachers. The major objectives of the Manufacturing Technical Semester are to provide:

(1) A means by which a student may be able to identify those elements and aspects of manufacturing that should be taught as general education; and

(2) The means by which students may learn how to translate knowledge of the work-a-day world into significant learning experience for the citizen.

The two industries which are assisting in the current technical semester are Fisher Price, Inc., of East Aurora, New York, and the Chevrolet Tonawanda Complex, which includes the motor, foundry and forge plants. These cooperating industries provide unique educational experiences for the college students through production and management-oriented seminars, supervised observations, and some work experiences on a forty-hour-a-week basis for a total of eight weeks. The college students not only have an opportunity to gain first-hand knowledge of latest innovations in the use of materials and processing techniques, but they also have an opportunity to observe and witness the psychological and sociological problems confronting industry both from the viewpoint of organized labor and management. The twenty work days that the students spend in each industrial complex are scheduled by the college supervisor in cooperation with the representatives of each of the two personnel departments.

The pre-planned outline of industrial exposure includes experiences in such departments as safety, production, inspection, material handling, standards, plant engineering, product engineering, labor relations and quality control. The work experiences are supplemented with weekly seminars conducted by various industrial experts and include discussions centered around research and development, systems, marketing, training, purchasing, traffic and employment practices.

During the industrial experience, the college student is observed by the college supervisor, who also conducts an end-of-the-week seminar on campus. This seminar provides an opportunity for the student to review any problems he has experienced with the group and to submit a critique of his week's work experiences. At the same session, the college supervisor attempts to prepare the student for the various experiences he will be exposed to during the following week by means of assigned reading and visual materials.

The college students spend the second half of the technical semester on campus developing the content outlines and organizational patterns necessary to be prepared to teach about the principles of manufacturing they have identified through individual research during their industrial internship. They also attempt to identify activities that will help to illustrate various industrial techniques and processes that will be meaningful to children at all grade levels. During the on-campus sessions, the students continue to be directed toward educational excellence by involvement in curriculum development sessions, school observations and participation, production planning activities, industrial visitations and the production of a representative product.

The school observation and participation includes sessions in the college campus school, or a junior and senior high school and elementary school. One elementary experience gave the college student an opportunity to serve as industrial arts consultant for a group of fifth-grade classes implementing an economics unit for their social studies curriculum. The college student organized the planning and production of three products that the elementary students had identified as exemplifying typical manufactured products.

The industrial visitations are also planned by the students and give them an opportunity to compare and supplement the observations of manufacturing processes and procedures they had experienced during their industrial internship. These visitations include industries producing furniture, steel, petroleum products, plastic materials, electronic components and automobiles.

The college students also coordinate a production planning course with a manufacturing laboratory during the second eight-week session. They operate a simulated corporation employing managerial and organizational principles, as well as functions pertinent to manufacturing concerns. The actual production takes place in area junior high schools after the college students have had an opportunity to orient and instruct their students concerning the planned production. The results of this experience are best summed up by a comment by one of the college students:

"All of us, as students, have experienced some sort of mass production in our technical courses, but few, if any, realized the effort and planning behind it. A professor can talk until he is blue in the face about planning, but until the student actually experiences setting up a mass production, he truly doesn't understand the operations involved."

Throughout all of these experiences, various professors in the industrial arts college staff are called upon as participants and resource personnel because of their technical or professional education competencies.

Hopefully each student will have a student teaching experience following the technical semester with a master teacher who was an earlier participant of the course, or has developed a manufacturing technology approach in his teaching of industrial arts courses. It is important that the college student have an opportunity to implement his newly-acquired knowledge as soon after the technical semester experience as possible, and student teaching presents that opportunity.

The evaluation of the technical semester is somewhat difficult at this point in time, because the actual test for this approach to technical competency in industrial arts education is to determine what effect it will have on the industrial arts programs and students in the schools of the nation. It is planned to do more evaluation when the college students have graduated and are conducting manufacturing courses in their own junior and senior high school industrial arts programs. For the present time, the evaluation must be centered around the accomplishment of the stated objectives which, according to students, have been very successfully achieved. This is exemplified by the following two student statements:

(1) "In critiquing this course, I would first like to say that the Manufacturing Technical Semester is packed with potential. As a student, I was able to see the existing gap between industrial reality and its representation in the world of education. I feel that the industrial arts students who go through this program are more knowledgeable of industry and the teaching behind it."

(2) "Although I have worked at Chevrolet for more than five years, and other large industrial complexes since 1957, I never realized how a company functioned, what its problems were, and how it attempted to solve these problems, until I entered the

Manufacturing Technical Semester."

When we see the involvement and interest expressed by the students at East Aurora Junior High School and the campus school at the college because of their exposure to a contemporary approach to the teaching of industrial courses, we are inclined to believe that the Manufacturing Technical Semester is very worthwhile. The course is advantageous for the college student because he now is able to relate intelligently to his students the meaning of contemporary industrial technology.

Dr. Brueckman is on the faculty at State University College, Buffalo, NY.

Manufacturing technical semester

Robert L. Serenbetz

As this is Chevrolet Tonawanda's symbol of the dawning of a new era, "The '70's", so it also represents the dawning of a new era of cooperation between industry and education in the preparation of teachers for the '70's.

As spring develops outside Chevrolet, our student interns develop in-depth understandings of manufacturing inside. Here we see two students analyzing material control as a teletype unit is used to index pistons to engine cases on the Mark IV line.

The receiving teletype unit is located at the assembly point in the line where pistons and cases meet. By analyzing the tape, the operator can mate the proper pistons with the case.

Quality control is a major concern in the manufacturing industries. Here one of the foremen in charge of quality control for the crankshaft department explains a "Pride of Workmanship" analysis chart at a concentricity inspection station.

Production engineering is a critical part of the industrial effort. One of our interns is involved in a time-study analysis on part of the automated engine case line.

Of course the total manufacturing effort relies on a thorough production planning effort. Here one of the Chevrolet staff reviews the production flow of the XP887 engine case.

From the drawing boards to the production engineering plotting boards, production processes are translated into models and followed through by student interns and the college supervisor who works on the site with the interns as part of a carefully-supervised program.

Chevrolet provides advanced technology as interns work with the latest in numerical control. The Sunstrand Omnimill here has been programmed to complete all machinery operations on the new die-cast XP887 engine case.

Here our interns load program tape and identify program readout for processing the XP887 case.

Every year industries like Chevrolet spend millions of dollars on safety. Student interns spend time analyzing safety motivational charts in the engine plant. Safety is a critical part of the manufacturing effort.

Materials must be continually monitored if a reliable product is to be manufactured. Metallurgical analysis using the metallograph is one of many methods used to check the structure of forged parts in the Tonowanda Forge.

Here we see the student interns involved in the metallurgy related to piston processing for the new XP887 engine. These pistons are plated in a sequence that sees them through 47 different operations before they are ready to be assembled into Chevrolet's new 4-cylinder engine.

Further checks on alloy content of critical parts are made using the carbon arc spectrometer.

Quality control is critical; accordingly every engine produced (some 150 million to date) must be factory-tested prior to installation in a vehicle. Here a student intern performs a sonic engine test as he listens for internal engine noise with a sonic bar under the direction of one of Chevrolet's engine test supervisors.

In a carefully-developed program random sample techniques are used to select and endurance-test engines under varying conditions. Student interns observe the endurance testing of an engine on a water brake dynamometer. Engines are run to failure then disassembled and analyzed.

Further quality assurance is built into the product here in the quality assurance laboratory. Very careful records are kept of those parts most often found to fail.

Material control and handling are also critical to the manufacturing enterprise.

The heart of the foundry operation is the cupola. Student interns develop understandings of the cupola operation in the cupola control room of the Chevrolet Tonawanda Foundry.

On the business end of the cupola interns work with Chevrolet Supervision as molten iron is drawn off for subsequent foundry operations.

As molten iron is poured from the ladle it must be metallurgically correct; here one of our interns awaits the addition of final alloy elements to two tons of molten iron.

Quality control is critical in foundry work just as it is in other manufacturing. Part of this control effort relates to core production and layout. The Chevrolet Quality Control Technician explains layout procedure and records critical information under the observation of the college students.

Back on the pouring line the molten iron is poured after quality is engineered into the potential casting through carefully-planned metallurgical and production efforts.

The student intern gets some hands-on experience as he operates a sand crane for loading pre-mixed hot box core sand into the core press hopper.

Further understandings are developed as a core press operator demonstrates the operation of a core press.

As is true in any manufacturing operation, production planning and engineering are of critical importance. The foundry materials flow patterns are explained by a process engineer on the foundry layout board.

Plastic forming of metals and the technology of forging as it relates to and becomes a part of manufacturing is analyzed as a student intern observes the production of axles.

The manufacture of tie rod ends by cold-upsetting one-inch steel wire becomes another part of the manufacture of forged parts.

Forging molds are developed with the aid of EDM. Special tin alloy electrodes are examined.

Heat treatment is yet another process that becomes part of the Chevrolet manufacturing effort. The intern takes readings which can be related to metallurgical analysis in the laboratory.

The intern group receives further instruction under a special program of seminars coordinated by John Hamacher, Supervisor of Education and Training. Those services related to the entire manufacturing effort are coordinated in an effort to tie the in-plant experience together.

The Fisher-Price Story. After four weeks our interns turn their attention from the heavy industry of Chevrolet to the light industry of Fisher Price Toys. Nestled in the foothills of southwestern New York, Fisher Price has found it possible to share their industrial expertise with our future teachers in an endeavor to build a better America through our schools. Recently this 40-year-old company, started by Herman Fisher in East Aurora, New York, joined hands with Quaker Oats.

As a result of this cooperative effort between education and industry, our student interns receive a broad view of the manufacturing enterprise from initial market analyses through product development to actual advertising and marketing. The point of origin, of course, is research and development. At the R & D Center interns receive an in-depth look at the creative development and design engineering aspects of the new product.

From model through prototype development in the model shop, our interns trace the evolution of the new toy.

The prototype must then be engineered into a manufacturable form. The design engineering department has the awesome task of developing a manufacturable child-proof toy.

Part of the ultimate product has to be child appeal. In the sound analysis laboratory student interns work with sophisticated sound analysis equipment.

If the product development has been carefully analyzed, the new toy endures the ultimate test of use in the experimental nursery school.

After further refinements the product is ready for manufacture.

The manufacturing enterprise must be a carefully-coordinated effort of production planning and production engineering. The student intern has the opportunity to study material flow and control as a part of manufacturing.

Tooling up for production always brings our students in contact with the tool room operations as they work beside tool and die makers.

As the intern works as a part of the maintenance department, he develops understandings and skills related to production line setup and maintenance.

In production engineering the intern relates engineering layout to the actual manufacturing line.

Material procurement, control and handling become strategic in importance as the manufacturing effort starts. The intern must grasp the overall picture of materials handling as critical to fabrication and assembly of the final product.

The processing of grade A forest product materials into the quality product is the initial step in fabrication. The intern has unique exposure to the most modern techniques used to process these materials.

Graphics and forest products meet as lithos are bonded to the wooden parts of the subassembly. Interns get actual hands-on experiences during the entire Fisher-Price portion of the program. In-depth analyses are made of the production line as the student intern works at the side of the production worker.

Quality control is a never-ending problem for modern industry. The college students get a unique exposure to the quality control program at Fisher-Price. This includes everything from visual checks to endurance tests of music units from Switzerland and Japan.

Package engineering is another aspect of the manufacturing effort.

After packaging, the product is conveyed to the warehouse, where some $50 million worth of toys are handled and shipped with the aid of specially-programmed carts and conveyors. Student interns spend time studying this highly-sophisticated method of product control and handling.

This system provides efficient methods of loading custom orders on motor carriers or bulk shipments on rail carriers.

During one week the college interns spend time at the Holland, New York, Plastics Division of Fisher-Price, one of the most modern plastics manufacturing operations in the world.

Injection- and blow-molded parts are produced here. The interns spend two days at the side of operators and technicians in each of these areas. The interns develop understandings of blow mold technology.

Injection molding is also studied under the direction of supervisory and production personnel at Fisher-Price.

In still another area interns have an opportunity to study and analyze shrink packaging techniques used by Fisher-Price.

Material handling becomes a unique problem in the plastics industry. The intern has the opportunity to analyze silo storage and direct system feeding of plastic materials to the press operator.

Environmental pollution is a continuing concern to all in our present industrial society. Fisher-Price disposes of waste, making use of pollution-free incinerator units.

Thus, Fisher-Price provides many unique technological experiences for the future teachers of industrial arts.

During the second eight weeks, the student intern develops and field tests the manufacturing enterprise in the school. This field test is presently being conducted in elementary and junior high school programs. The following sequence is a record of a manufacturing enterprise as a part of a 5th-grade economics unit in an open-plan 94-student 5th-grade program. Here the interns acted in the capacity of consultants as they developed the manufacture of candles for the Wonderful Wax Company at the Country Parkway School in Williamsville, New York.

After the product is identified by the 5th-grade class, the college interns develop models and design prototypes. In this case, because candle-making is a technology unique unto itself, the interns sent four of their group to local candle industries, to evolve design prototypes for decoration.

While decoration is being considered, so is packaging.

Candle prototypes are also developed by the interns as they endeavor to develop a realistic manufacturing enterprise using the industrial technology gained from two local candle industries.

Part of the prototype development involves the 5th-graders. The college interns worked closely with the 5th-grade class in determining the final product design.

As the project develops, it is essential that the 5th-graders understand the technology of candlemaking. The college interns share with the class some of their findings as they surveyed the manufacture of candles.

The manufacturing establishment evolves. The next task is to train 94 5th-graders in order that they can manufacture 300 candles complete with packaging, decoration and supplemental information in three hours.

The interns must test-operate the manufacture of the product, and during this test they videotape all critical operations. The entire class receives a 10-minute video orientation to the operation of the manufacturing enterprise.

While most of the 5th-grade class is attending the orientation on video-tape, eight menbers of the class are being oriented by the interns in order that they may function as foremen.

The manufacture begins with wax preparation. Paraffin is removed from the package and distributed to the first operation, where the wax is broken down into smaller pieces to aid in melting.

Other pieces of wax are supplied to the grating operation where the wax is reduced to a fine chip. These wax chips are placed in the molds to aid in the solidification process.

Plastic cups are used as molds. The students punch the bottom of the cups and place a wick through the hole. They then seal the wick to the bottom of the cup with clay.

The wicks are held upright with large bobby pins as the wax is poured into the cups by the 5th graders.

Further down the line the decoration subassembly begins with the die cutting of 4-inch styrofoam discs.

These discs then have tinsel garland fastened to their edges using a stapler mounted on the work bench.

Quality control, materials handling and storage all become a part of this subassembly operation.

The package subassembly begins with special fixtures used to score the package cardboard prior to folding.

Fifth-graders load the pie-cut package blanks into the scoring fixtures.

After scoring the package, tops must be decorated. A special jig guides the decorating stamps to the appropriate part of the prescored package.

The stars on the jig and the stamps are lined up or matched to insure proper application of the stamp to the package.

The package next moves down the line where the ink is dried prior to folding. Next the package is folded prior to fastening. Fastening is done with special stapling fixtures that locate the staple at the proper place.

After stapling, the packages are stored until the products are packaged. Inventory control is important.

The four-teacher team is also involved as one of the teachers examines package subassemblies at the end of the line.

When workers become tired, there is relief as a group of 5th-graders rest in the break area.

As the production runs, so the students must keep track of finances. The president and the treasurer record credits and debits. The students set up and sold stocks to raise funds.

Back on the assembly line, students initiate the final assembly as they strip the cup molds from the candles.

After trimming the wick, the candle bases are trimmed prior to further decoration.

Next, the candles are rolled on a sponge saturated with shellac, after which they are rolled in glitter.

The candles are next moved to final decoration assembly, where a tinsel garland is fastened to their base, using the staplers in the same way the garland was attached to the styrofoam.

The students next weld the candle to the styrofoam base by dipping the base of the candle in molten wax.

A Christmas greeting and instructions for the proper use of candles brings the students into contact with graphic arts as they print these instructions two-up. After printing, the messages are cut on a very carefully-guarded paper cutter.

Next, the greetings are folded and then supplied to the packaging line, where they are placed in the bottom of each package. The candles are then placed in the packages, and the tops of the packages are placed over the bottoms.

The Final Products are then moved to storage, where they await marketing.

Mr. Serenbetz is on the faculty of State University College, Buffalo, NY.

The professional semester internship

William J. Weaver

The professional semester internship is, I believe, worthy of our attention as a significant advancement in the field of teacher education. Being the first member of our staff to become actively involved in carrying out this program in its infancy, I have experienced times of frustration as well as many satisfying experiences. Perhaps you might consider this a testimonial as I share with you some of my reasons for being enthusiastic over this program.

Turn back in time in your own mind and try to recollect, if you can, your own student teaching experience which was, no doubt, a semester or two removed from your teaching methods course. Things that did not seem important then are suddenly vital, but the class is over and past. Contrast this with the opportunity that the student intern has in receiving his class work week by week during his internship, as he needs it and can apply it. An example of this would be in the organization and development of the teaching unit. The student intern who has been working with and observing 7th- and 8th-graders benefits more in preparing and teaching a unit for these pupils' needs and understanding, more so than in a situation where the lessons are prepared and taught in the college classroom for one's classmates.

The fact that the internship is based on 18 weeks in one situation rather than on two nine-week situations has, from my viewpoint, several advantages. The student has more opportunity to follow through with individual pupils and to observe the results of teaching and perhaps experience results in working with some special problem case. Also there is a greater opportunity to become involved in other school activities and to be able to complete projects started with these groups. In the academic area, one student intern was afforded the opportunity to teach a math class which his supervising teacher was responsible for. In a nine-week situation the teacher, no doubt, would not have considered his participation in this experience. This was also a result of careful consideration in placing students and matching interests and abilities with those of supervising teachers. Another student found that he had over forty interested pupils when he offered to teach the fundamentals of judo during an activity period.

Not many of us really enjoy committee work, but there is always a certain amount that is necessary, and the student intern who is allowed to participate in any of these groups gains valuable experience. To cite an example, one student while working on the report card committee assisted in the design of a new report card.

The relationship between the student intern, the supervising teacher and the college supervisor is very important and, I believe, has more meaning in the setting of the professional semester because there is more contact among these three. Ordinarily the college supervisor would make approximately three visits to observe a student and for conference. In the professional semester situation the supervisor meets with the entire group at least once a week for instruction and discussion, plus the individual observations and conferences.

The key to the effectiveness of any student teaching situation is the supervising teacher and his understanding of the role he is to play. Because there are significant differences between this and the former program, it is necessary for the college supervisor to work closely with the supervising teacher so that the student intern benefits from his teaching experience. This has pointed out the need for in-service classes for supervising teachers so that they may learn exactly what their roles should be and thereby produce more uniform experiences for the student interns. It is my opinion that such a course should be required and that upon completion credit be given toward certification.

This is not the extent of my feelings about the worthwhile aspects of this program, but time would not permit more. Certainly, changes have already been made in the original experiment, and I'm sure that others will be made, but I am confident that students are benefitting from this professional semester and that it will move ahead and prove its worthiness in the '70's.

Mr. Weaver is assistant professor of industrial arts, State University College, Buffalo, NY, and is presently a Resident Supervisor of Teacher Education for the ELCORBA Center.

Contemporary concepts of industry in a teacher education program

Joseph W. Duffy, Andrew W. Baron.
Dale H. Messerschmidt and Robert H. Thompson

The pundits of industrial arts education have expressed a major concern in aligning what is being offered in industrial arts programs with what is practiced in industry. Technology today requires individuals to possess sophisticated knowledge, to be mobile and to be flexible in their thinking.

The progress of technology is sequential, proceeding from that which is fundamental to that which is highly technical. If industrial arts is to reflect contemporary technology, it should find its base in technology's origin and provide insight into the concepts and principles that technology employs as it evolves in satisfying the needs of society.

Communication between industry and education is lacking. Technically speaking, the financial status of our schools and the professional outlook of teachers have caused educational progress to lag. These constrictions, however, may not be as significant as the philosophical rationale that provides direction and purpose for an educational program. Moreover, educational rationale is vital to any curriculum because it provides the framework within which courses are conceived and taught.

The Industrial Arts Department at Central Connecticut State College recognized that the practice of offering a proliferation of courses dealing with tools and materials, independently and not conceptually, could not be tolerated because it was not educationally efficient. Transfer of learning must be designed into a curriculum in order to permit fragments to be related to wholes, and for concepts to be developed.

As a teacher preparatory institution, the College has assumed the obligation of providing leadership. We recognize that prospective teachers, for the most part, teach as they have been taught. We have conceived, therefore, our course offerings which employ contemporary teaching methods to serve two functions. First, we must present course content; and second, we must provide an opportunity for concepts of industry to be formed. These courses, with modification, may serve similar purposes within the spectrum of the junior and senior high school general education programs. Before the College Industrial Arts Department was able to delimit the study of industry so that it could be presented effectively in a curriculum, it had to agree on a workable definition of industrial arts.

Definition of industrial arts. Industrial arts is an activity-oriented curriculum area within general education which is primarily concerned with developing concepts of the functions of industry. It includes the study of material, energy and information processing; the provision of service, and research and development; as well as the organizational, managerial and socio-economic aspects of the American industrial complex.

In further delineation of the above definition, it may be necessary to state in more exact terms just what is intended. Our industrial arts programs continue to be activity-oriented because we believe that activities have a sound psychological base. The activities in our program surround the usual tools and machinery found in any industrial arts facility. Lathes, mills, grinders, circle saws, injection molding equipment, vacuum formers, volt meters, an aviation trainer and other machinery are evident. And, the curriculum acts as an organizational agent so that people, time and facilities can be utilized effectively. In addition, the Industrial Arts Department at Central Connecticut State College continues to emphasize the relationship of industrial arts to general education.

In relating industrial arts to the goals of general education, the usual goals for general education are accepted. We believe in the goals of general education that lead to transmitting a way of life and improving that way of life through advancement of the individual and his personal needs. General education, both formal programs and informal activities, are designed for the total general population continuum. Included in the continuum are males and females, young and old, bright and dull, and other contributors to the gamut referred to as a general population.

It is the belief of the Industrial Arts Department faculty of Central Connecticut State College that the department's uniqueness is derived from its organizational approach to subject matter. It is our effort to group materials around concepts. Of course, American industry is the source of information around which concepts are formulated. We also recognize, however, that concepts have specific properties.

If we accept the definition that a concept is basically a mental image and that that image has specific properties, we can proceed with a description of how our conceptual approach to industrial arts operates. First, a concept can have a type of intrinsic dimension. Based on certain observations of the intrinsic dimension, a classification can be ordered. For example, certain industrial materials began the operational cycle as living organisms, or parts of a living organism. The leather that we carve in a crafts class at one time was live and covered an animal. The piece of lumber that we process in a woods class at one time was also live. Although the chemical properties of the two original organisms differed, their growth characteristics were similar in terms of cellular properties. A second ordering of a conceptual organization involves the use of the object. For instance, the physical difference between a diamond and a knife blade are quite marked; however, both the diamond and the knife blade can be used as cutting tools. Hence, the concept cutting tools are ordered by the use of the item. Yet, we must be cognizant of the fact that very definite cultural factors are frequently involved with an organization of concepts that require use for that classification. In American industry the diamond is usually considered as an abrasive; but many other cultural patterns would not consider using a precious stone as an abrasive. Third, a concept may be defined in terms of behaviors or operations. Klausmeier and others have used the example of intelligence measurement as a demonstration of conceptual behavior. An example of conceptual behavior more germane to industrial arts may deal with the properties of materials. When heated and cooled rapidly, certain ferrous alloys become noticeably harder; whereas a nonferrous metal, when heated and cooled rapidly, becomes noticeably softer. It is through a conceptual organization of thoughts, ideas, properties, functions, operations, and so forth, that the Central Connecticut State College Industrial Arts Department presents its program.

The content for a conceptual approach to industry, as has been pointed out previously, must be derived from American industry. Quite simply, and quite frankly, the ultimate goals of this department are no different from those of other curricular organization patterns. We wish to describe and demonstrate how American industry changes a raw material into a finished product; we wish to relate the role of American industry in the American cultural pattern; and we wish to have our product, teachers for the public school systems, be able to transmit this knowledge to public school populations.

Objectives of industrial arts.

(1) To develop the ability to think rationally about the interdependence of man, society, industry and physical environment.

(2) To develop an understanding of our dynamic industrial complex and its socioeconomic influence.

(3) To discover and develop interests and capabilities of students in technical and industrial fields.

(4) To develop techniques of problem solving as they relate to industry and the reinforcement of academic skills.

(5) To develop desirable behavioral patterns, including safe and efficient individual and group work habits, providing an awareness of cooperation, tolerance, leadership, followership and tact in an industrial environment.

(6) To develop aesthetic appreciation for craftsmanship and design and to encourage creative learning experiences within the industrial context.

(7) To provide for the development of occupational orientation and avocational interests, including those which are unique to a community.

The above objectives for industrial arts are very similar to the objectives of other industrial arts teacher education institutions. In spite of the similarity, however, they must be stated again to insure that all staff members of Central Connecticut State College are aware of the ultimate end to which we strive. Then, in order to be more certain that each staff member could identify his contribution to the ultimate end, additional delineation of the end was made. These statements follow in our "Statement of Purpose for the Department", and "Departmental Guidelines".

Statement of purpose for the department. The success of any program is a direct reflection of the capacities, beliefs and coordinated efforts of people affecting the program.

The Industrial Arts Education Department has several major responsibilities toward industrial arts education.

(1) The promotion of a philosophy of industrial arts education as exemplified by the foregoing definition and statement of industrial arts objectives.

(2) The responsibility of graduating a prospective industrial arts teacher with the

knowledges, skills and attitudes essential to success (this being a strict vocational goal).

(3) The assumption of a leadership role for the industrial arts programs in Connecticut.

(4) The fulfillment of the basic objectives of industrial arts for the College community.

Departmental guidelines. To provide a more effective teacher education program, the following will be fostered in the student:

(1) The desire to develop and apply a realistic, personal philosophy of industrial arts education.

(2) The recognition of the need for following a carefully-planned, yet flexible, course of study.

(3) A sense of obligation to accomplish all of the objectives of industrial arts education.

(4) A cognizance of the importance of possessing the knowledge and skill of industrial arts.

(5) An insight into the methods and techniques most appropriate for successful teaching, including an emphasis on transfer of learning.

(6) An understanding of the development and proper use of the total learning environment, including instructional materials and other like resources.

(7) The acceptance that each course has a unique academic and technological orientation.

(8) An awareness of what constitutes good shop planning and organization.

(9) The understanding of the importance of practicing safety.

(10) The awareness of the importance of keeping a clean and orderly laboratory.

(11) An understanding of the significance of selecting textbooks and other resources which are suitable for various grade levels in the several industrial arts areas.

(12) An appreciation for the use of various types of evaluative techniques.

(13) The recognition of, and active support of, professional organizations.

(14) The desire to relate to his teaching situation any significant development in his field.

(15) An enthusiasm for industrial arts as a teaching profession.

Curricular organization - Lower Division. At Central Connecticut State College we have identified material processing, energy processing and information processing as three of the major industrial functions. With regard to curriculum, we therefore thought it appropriate to provide all students entering the department with exploratory experiences in each of these areas. Consequently, at the head of our curricular list, we have included three required courses which concern a survey of material, energy and information and ways in which the three topics are industrially processed to human advantage. These courses are prerequisite for all other departmental offerings, and the courses are designed to provide a foundation on which further study can be based. It is necessary to describe these courses in some detail, particularly with emphasis on methods, scheduling and content.

Introduction to Material Processing. Introduction to Material Processing is a course which introduces concepts of how industry changes forms of raw materials to increase the materials' value and usefulness. In this course, an awareness of the nature and the characteristics of raw materials is developed, thereby permitting associations to be made regarding the selection of processes by which materials may be changed.

To establish the content for this course, certain concepts of matter and its processing were identified and organized into a logical sequence for study. For example, some of the concepts discussed in the "Introduction to Material Processing" are: cutting, forming, casting, fastening, treating and finishing. We believe it particularly important to emphasize those concepts which are timeless and possess universality of application.

The materials processing course, as well as the other introductory courses which will be described, is team-taught by three faculty members. The class size is limited to sixty students, thus keeping the student load of each faculty member teaching the introductory courses approximately equal to faculty loads for all other offerings in the program. The class meets as a whole for lecture/demonstration presentations of content. After several presentations, the large group is divided into three sub-groups which meet under the supervision of one of the faculty team. In the sub-group, the class, through laboratory activities, explores the concepts previously presented. It is in this setting that faculty guidance and student work are employed to develop and to reinforce each of the basic concepts. Sub-groups then rotate through various laboratories dealing with fibrous materials, metallic materials, and ceramic and plastic materials in subsequent meetings. It is in the above laboratories that each student has the opportunity to develop each concept as it relates to a variety of materials.

Student evaluation happens to be one of the necessary aspects of every teacher preparation program, and it is therefore an aspect of the conceptual approach to industrial arts. During the course, students are evaluated on the basis of laboratory performance, and pencil and paper examination scores.

Introduction to Energy Processing. The "Introduction to Energy Processing" acts as a survey of the forms of energy and the conversion processes employed by industry to increase the value and usefulness of energy. Content in the above course is derived from basic concepts concerning man's use of energy. For example, some of the basic concepts of energy are: kinetic, potential, conversion, efficiency, reaction and conservation.

Laboratory facilities which lend themselves to student activity sessions are primarily the electronics laboratory and the power mechanics laboratory. During laboratory sessions, efforts behind active student involvement are, again, to provide for reinforcement of the course content.

Introduction to Information Processing. The purpose of the course entitled "Introduction to Information Processing" is to teach concepts of information and the processing of information to increase its value and usefulness. The actual course is geared to three generalized theoretical models. Student laboratory work then has emphasis placed on relating existing information systems to the appropriate theoretical model. The information systems are later fragmented for analysis and the development of each conceptual content element. Concepts of information processing covered in the course include: encoding, noise, selectivity, logic, error and feedback. To demonstrate each of the concepts, we use the three information-processing models.

The Shannon-Weaver model for communications systems is the first generalized model used for study. The second model used for study purposes is basically a computation system which includes sub-systems such as: data input, output, program memory, data memory, process control and arithmetic. The third and final model used for study purposes is one portraying the general structure of open- and closed-loop control systems.

Activities specifically tailored to a study of the ways in which information is processed for communication, computation and control are carried out by the students during laboratory sessions. Again, the activity is designed to permit a conceptual development to take place. Laboratories which are used in the information processing course include the graphics, drafting and electronics facilities.

It must be pointed out that in viewing the total picture of American industry, there are certain interrelationships within and between material, energy and information processing which the student must learn to seek and to recognize. No one of the previously-described areas of study stands independently. We believe, therefore, it is desirable to provide the student with certain experiences that involve some or all of these three areas simultaneously. To achieve the goal of simultaneous study in three areas of instruction requires a revision of our program. And as long as we believe students gain by curricular revision, we will work toward that goal.

Curricular organization - Upper Division. It is relatively simple for an institution of higher education to change its curricular offerings to meet specific goals established by that institution. But it goes without saying that all of us are faced with practical considerations that must be observed also. In the State of Connecticut, certification requirements are established by statute, and of course the requirements must be met.

In addition to the required courses in general education and professional education, regulations for teacher certification in industrial arts state that a person must "...have a minimum of thirty-five hours' credit in appropriate technical courses in a planned program designed to develop competency in the special field to be taught and including the particular areas as noted for each subject...." Specifically, the areas required for industrial arts are: drafting, metalworking, graphic arts, electricity, power mechanics and crafts.

By working within the established framework of certification requirements, and the department's objectives, the current program was established. At this time a total of fifty semester hours of work within the industrial education program is required for graduation. Included in the total program are the required survey courses in each of the primary areas of technology.

IA 113 - Introduction to Information Processing 2 Sem. Hours

IA 114 - Introduction to Energy Processing	2 Sem. Hours
IA 118 - Introduction to Materials Processing	2 Sem. Hours

Additional required laboratory courses in the seven areas of technology include:

IA 121 - Technical Drafting	3 Sem. Hours
IA 212 - Graphic Arts Industries	3 Sem. Hours
IA 213 - General Electronics	3 Sem. Hours
IA 215 - Materials Processing I	3 Sem. Hours
IA 216 - Materials Processing II	3 Sem. Hours
IA 217 - Materials Processing III	3 Sem. Hours
IA 314 - Power Transmissions and Control	3 Sem. Hours

The above seven courses are designed to meet certification requirements in industrial arts and to provide breadth for the prospective junior high school teacher. These requirements, we believe, are necessary because junior high school industrial arts teachers are required, frequently, to teach a broad-spectrum program. An additional twelve semester hours of required courses complete the professional aspects of the curriculum.

IA 110 - Orientation to Industrial Arts Teaching	1 Sem. Hour
IA 211 - Fundamentals of Design	2 Sem. Hours
IA 300 - Teaching of Industrial Arts	3 Sem. Hours
IA 408 - The Service Industries	2 Sem. Hours
IA 418 - Industrial Processing	2 Sem. Hours
IA 428 - Research & Experimentation (in area of concentration)	2 Sem. Hours

At this time in his planned program, a student will have completed a total of thirty-five semester hours. The remaining hours needed to meet graduation requirements are scheduled in the area of concentration.

The elective courses in industrial education and industrial arts make it possible for each student to prepare areas of concentration for teaching in the senior high school, and in certain specialized areas of education. Following is a list of elective courses available:

IA 247 - Industrial Arts Handcrafts	3 Sem. Hours
IA 316 - Metals Machining	3 Sem. Hours
IA 337 - Ceramics	3 Sem. Hours
IA 342 - Relief and Porous Printing	3 Sem. Hours
IA 344 - Transportation	3 Sem. Hours
IA 345 - Related Wood Technology	3 Sem. Hours
IA 359 - Industrial Arts in Elementary School	3 Sem. Hours
IA 441 - Architectural Drafting	3 Sem. Hours
IA 442 - Lithography	3 Sem. Hours
IA 443 - Information and Communications	3 Sem. Hours
IA 444 - Power Train Diagnostics	3 Sem. Hours
IA 445 - Construction Industries	3 Sem. Hours
IA 446 - Tool and Die Fundamentals	3 Sem. Hours
IA 447 - Plastics	3 Sem. Hours
IA 461 - Advanced Technical Drafting	3 Sem. Hours
IA 462 - Advanced Graphic Arts Technique	3 Sem. Hours
IA 463 - Information Computation and Control	3 Sem. Hours
IA 470 - Ind. Arts for the Exceptional Child	3 Sem. Hours
IE 400 - Test Measurement in Ind. Education	3 Sem. Hours
IE 433 - Techniques of Conference Leading	3 Sem. Hours
IE 440 - Ind. Arts in the Urban School	3 Sem. Hours
IE 464 - Aerospace Education	3 Sem. Hours
IE 469 - Driver Education	3 Sem. Hours
IE 479 - Traffic Safety and Driver Education	3 Sem. Hours
IE 480 - History of Industrial Education	3 Sem. Hours
IE 489 - Stored Programming Concepts	3 Sem. Hours

Graduate program. The program leading to a Master of Science Degree in Education was instituted by Central Connecticut State College in 1955. However, it was in 1959 that the first candidate for a Master's Degree in industrial arts education was matriculated. The above time lapse should be noted, because the State has few institutions which offer the Master's Degree in industrial education.

If one views the following graduation data, one can readily observe the effect that the thesis requirement had on the initial graduate program. As soon as the option of a comprehensive examination in lieu of the thesis was entered, the graduation figures changed dramatically.

Year	Graduates
1965	5
1966	14
1967	53
1968	32
1969	32

Currently we are completing the first year of what is for us a different approach to the graduate program. Faculty begin with the assumption that an academic advisor can be of greatest assistance to those graduate students who know where they wish to be in five years, ten years and twenty-five years. From that data, the student and his advisor can plan cooperatively a graduate program. Of course, the usual difficulties arise when a candidate simply wants a degree to satisfy permanent certification requirements.

The present Master's Degree program is organized in such a way that the student can direct his program to coincide with his professional ambitions. We offer four reasonably well-defined alternatives, and these alternatives include administration and supervision of industrial education, curriculum development in industrial education, industrial education instruction, and research in industrial education. All areas include what may be called specific requirements, alternative requirements and electives. For example, all Master's Degree candidates are required to take the following:

Math 453 - Applied Statistical Inference *or*	3 Sem. Hours
Math 533 - Elementary Statistical Methods	3 Sem. Hours
Ed 500 - Contemporary Educational Issues	3 Sem. Hours
Ed 510 - Professional Problems of Teachers	3 Sem. Hours
Ed 598 - Research in Industrial Education	3 Sem. Hours
Total	12 Sem. Hours

Depending on the student's professional ambitions and concentrations, he is required to schedule one of the following courses:

IE 190 - History of Industrial Education	3 Sem. Hours
IE 231 - Contemporary Industrial Education	3 Sem. Hours
VIE 190 - Principles of Vocational Education	3 Sem. Hours

The remaining fifteen hours of course work are scheduled on a cooperative basis between the student and his advisor. Within the Division of Technology, courses are offered for both vocational industrial education majors and industrial arts education majors. Additional course options are available throughout the college in philosophy, psychology, sociology, business administration, educational media, and so on.

Exit requirements for the Master's Degree demand that the student meet the minimum requirements of the department and the college. Prior to writing the comprehensive examination, the student must complete a minimum of twenty-one semester hours' work. If the candidate elects to write a thesis, he is required to take twenty-four hours of course work. However, the candidate electing to write the comprehensive examination is required to complete a total of thirty semester hours of course work. At this time Central Connecticut State College has only two routes for obtaining a Master's Degree. One avenue requires a thesis, and the second requires a comprehensive examination. Of course, changes in both the undergraduate and graduate program will evolve, and we anticipate change. We also trust that changes will be to the advantage of the students, and that the changes will be both appropriate and timely.

Messrs. Duffy, Baron, Messerschmidt and Thompson are on the faculty of Central Connecticut State College, New Britain.

Student morale—working together

F. J. Cackowski

The topic of student morale in the classroom of today is actually interwoven with the student himself and with the specific curriculum presented to him by the classroom instructor. Low morale in my own classroom has resulted from the ever-present racial problems existing at my particular school. Although racial problems are the basis for my comments to follow, low morale in the classroom may be attributed to many other problems existing in any given school at any given location.

Sensing low morale is perhaps one of the easiest problems to detect in a racially-troubled school. Students have a tendency to lock their academic problems within themselves and to express only the racial overtones due to unrest. As a teacher, it is my duty to counteract this immediate problem to further the academic progress of the students as individuals and as a group, thereby benefitting the entire class.

Regardless of the philosophies concerning curriculum content of the individual instructor, I feel that what I term the "project team method" is perhaps the most rewarding method of counteracting what I have mentioned above. In seeking a method to teach drafting whereby all students will learn how to work together in order to solve a common problem, I immediately saw all individual tensions tossed aside in order that the common problem be solved. After doing some research, I presented the students with a design problem that was designed in such a way that the final outcome would take the sincere efforts of all involved. The students selected their own leaders and created their own problems. I distinctly remember one individual student who was the so-called leader of a group of trouble-makers. As the problem became more detailed, he took a great deal of interest, realizing the fact that his cooperation was just as necessary as that of any other student involved in the project. He began to work and learn with others. I am quite sure that my students learned more about how to work with others, to solve common problems, and how to learn more than I could ever expect during a lecture or some individualized project. As the instructor, I began to see that I was taking the role as one to direct or guide. I was actually learning right along with the students, and this fact alone sold me on this particular method of construction.

I realize that this is not a new idea in the field of education. In a recent article that I wrote on this same method of curriculum presentation, I was amazed at the number of letters I received asking me to send more details on the project. I began to wonder how many people were actually giving any thought to this method of presentation, even if it was an accepted goal of some educators.

I feel that such items as facilities and administrative problems do not present any difficulties as far as this method is concerned. Of course, facilities will further enhance a method of this sort, but any teacher taking the initiative to plan such a method can make it work regardless of the situation. The social contact among the students is the actual key to the entire method.

Many instructors are fearful of incorporating some of the innovative ideas in the field of industrial arts, probably because of lack of knowledge about such programs. Perhaps the change is too great, and we need a gradual change in order that the instructor himself might "see the light". The methodology for a project of this sort need not only concentrate on what we will achieve for the student in the future, but also on what is important for the present. A popular television commercial begins with a small sequence saying that the theme of the country today is to live, work and play together. If this theme of togetherness is a priority, I feel that we as industrial arts educators can get the job done better than anyone else, because of the physical make-up of our classrooms alone.

The student involvement combined with the professional commitment of the instructor associated with a method of "learn by doing" can only result in the true fruits of learning.

Mr. Cackowski is a member of the faculty at LaSalle High School, South Bend, Indiana.

Why I belong to AIASA

Jim Kautz

I feel the single most important item in the teaching of industrial arts is a good student-teacher relationship. An industrial arts course has more personal contact than any other course taught in high school. If the student and teacher don't have a good relationship, very little if any will be learned.

Here I have a Louisville Slugger (baseball bat). It is only a piece of wood, but I feel it represents much more. You have all taught someone how to hold and swing a bat. There is a proper position for the hands and a proper way to swing.

This bat was turned on a lathe, a relatively simple machine to operate. Most industrial arts teachers have taught students how to use a lathe, showing him the proper and safe way to hold the tools and how to adjust the machine. Think about how much personal contact this takes. If there is not a good relationship the student won't listen and won't learn.

This is only one example. If applied to a whole shop you can see how important that relationship is. I feel the best way to achieve this positive relationship is through industrial arts clubs. Clubs present a slightly different student-teacher relation, one of planning and inventing. They are working together. This promotes understanding. Each will learn what the other likes, wants and needs. Each party will adjust his thinking toward the other. I have witnessed this, and firmly believe it to be true.

I feel time is a very important item. I have never had enough lab time to satisfy myself. Club meetings provide this time. They also allow additional projects to be undertaken, such as community service, and money-raising campaigns.

Let me get back to my baseball bat. It represents something else very important to me: the annual convention. This is the second one that I have been fortunate enough to attend. The bat was given to me by a local company after I finished their tour. If I had not been a member of AIASA, I would have never taken their tour or the many others in Las Vegas and in Louisville. I would not have met all the people at the conventions. I would not have spoken at that convention. I would have never seen the excellent exhibits. Nor would I have any ideas on how to improve industrial education, which is what the convention is all about. I don't have a lot of ideas; very few people do. But I do have a few, just as everyone does. When people come together, their ideas come together.

I am saying communication is the important thing in this, or any organization. The club newspaper, the SCENE, provides club news periodically. At the national and state conventions information is exchanged annually. State conventions are very important because a large part of the student membership can attend to express their ideas and opinions.

Only a small percentage of student members are able to attend the national convention. Even so I feel the national convention is very important because it allows all of the ideas expressed at state conventions to be brought out and discussed.

In conclusion I would like to say that my three years in AIASA have been some of my most memorable. I will never forget my experiences during that time, especially that of having thirty boys and a Lions Club working behind and for me to send me to such an important convention.

Mr. Kautz, who is just finishing his term as vice-president of AIASA, is a member of the class of 1970, Hamilton, Montana, High School.

The mechanics of affiliation

John O. Murphy, Jr.

For years we have been searching for a method of dramatizing and expanding industrial arts programs, when all this time the answer to the problem has been in our classrooms. If organized and encouraged properly, the student club could be the greatest single concept ever used to promote industrial arts education.

Many of our professional organizations are beginning to look to the clubs for the future. For example, Edward Kabakjian, Executive Secretary, American Industrial Arts Association, recently had this to say in a letter to the Louisiana Association of Industrial Arts Clubs: "The AIAA looks upon its clubs as a vital service to the youth of the public schools throughout America. They represent the lifeblood of future leadership and direction in industrial arts education."

One of the most important single aspects of an industrial arts club is the promotion of industrial arts. If properly used, industrial arts clubs can advance the program. For example, a student from any school in any part of the state attends a state or national club meeting. This student's school offers only the field of woodworking. When the student arrives, he views projects constructed in schools from all sections of the state in fields such as graphic arts, metal working, electronics and plastics. Following this, he begins to talk to other industrial arts students concerning their varied courses. When the student returns home, he tells his parents and friends about the industrial arts programs he observed. The parents ask the local school personnel, "Why don't we offer these programs?" What better way can you think of to stimulate industrial arts? Not only is this method of public relations helpful, but one should also consider that when these students who have had these experiences become adults, they, in many cases, become teachers and leaders in the community.

In an address to the American Industrial Arts Association in 1969 at Las Vegas, W. A. Mayfield, then Texas State Supervisor and a leader in the National American Industrial Arts Student Clubs, pointed out some ideas about industrial arts clubs which are interesting to note:

> Our students are our best public relations avenue. Through our students, we must justify our laboratory needs, our instructional materials and our educational goals. Unless we run a student-oriented program, we can't justify our place in the total educational program. Student club activities can serve to bring you and me out of that ivory tower down to where the student is, where the action is, where learning time must take place. As a professional organization in the field of education, our basic concern for education relates directly to the student.

Industrial arts clubs, through state meetings and programs, offer the students several activities which lead to an improved program. Some of these activities are as follows: Industrial tours, commercial exhibits, contests and awards programs, summer camp and an annual convention. These activities are very worthwhile educational experiences within themselves, and would be difficult to offer if a state were minus clubs.

More and more each year, demands upon the teacher's time in professional organizations, community relations, study of new methods, etc., take away valuable instructional time. Industrial arts clubs, although many teachers believe the contrary, can free more time for instruction. For example, an outstanding industrial arts program or any educational program should begin with the motivation of the students. When the student is properly motivated in an area of study, there is a desire to learn the subject matter. Interested students require less time to teach than uninterested students.

At one time in education, teachers based programs on the idea that all learning should be based on fact. In other words, the teacher presented the fact and the students learned them. Today's educators have learned the preceding is not the way – first, the instructor motivates the students and then presents the concepts for them to learn. Industrial arts programs are presently in the process of losing numerous motivating devices, in that they have been based on learning by doing, and now, as the subject becomes more technical, there is less doing, which has been the key to motivating many students.

Industrial arts clubs can be the motivating force for many students. It is interesting to note that the motto for industrial arts clubs is "Learning to Live in a Technical World." We must realize that the classroom is not a world; it is only a laboratory, and students should observe the technical world for which they are being prepared. Also, it is impossible for teachers to include all educational activities needed in the regular classroom; therefore, the club is needed to balance the educational program in our public schools.

I would like to present some basic answers and information which we hope will aid you in your affiliation. In Louisiana we have found that clubs can be the heart of our industrial arts curriculum. Our Association is the motivating force behind many of our industrial arts programs. In order to give you a better understanding of the processes involved in organizing a state association, let us present a brief history of LAIAC and an outline of Louisiana's industrial arts program.

In our public school system we offer as an elective course industrial arts education, which is a prevocational course and deals with the materials, processes and products of manufacture, and the problems of those engaged in industry. The three major goals of industrial arts education are:

(1) Provide for general education experiences representative of a dynamic industrial culture.

(2) Provide for broad general preoccupational experiences to assist those who hope later to enroll in specialized occupational education courses or to enter the labor force from high school.

(3) Provide pre-professional experiences for those who anticipate continuing their education in the fields of technology, engineering, science, education and architecture.

The learnings come through the pupils' experience with tools and materials and their study of resultant conditions of life. We try to offer a variety of subject areas, giving as much of a cross-section of our local industries as possible. We explore through industrial methods, wood, metals, plastics, electricity, motor mechanics and other products of industry. As an integral part of learning in the industrial arts education program, the students joined together in a statewide organization called The Louisiana Association of Industrial Arts Clubs, Inc. (LAIAC), which is a chartered non-profit organization of the State of Louisiana. LAIAC was organized March 22, 1958, in Alexandria, Louisiana. There were twenty-one industrial arts departments from which the junior and senior high schools of the state banded together and developed the association.

LAIAC has grown from its original 21 clubs and approximately 400 members to 50 clubs and 1,424 members in 1969. We believe that the LAIAC was the first student organization in the United States that sponsors a college scholarship for one of its members. The members tax themselves fifty cents per year to give a selected senior a $100-per-year college scholarship for four years.

The student members nominate and elect their own officers: These are the president, vice-president, secretary, treasurer, parliamentarian and historian. Three additional members are elected to the executive committee, and eight sponsors (one from each Congressional District) are appointed to serve on the Advisory Council. The state Advisor and the Executive Secretary are members of the staff of the State Department of Education. The various clubs that are members of LAIAC compete for several awards. These are: Outstanding Club of the Year, Outstanding Sponsor of the Year, Honorary Club of the Year, First-Second-Third Place Scrapbook, Parliamentary Law, Public Speaking, Outstanding Club Display, Crafts, Woodworking, Drafting, Electricity/Electronics, Metal Working, Technical Speaking, Technical Writing, Graphic Arts, Power Mechanics, and First-Second-Third Best Representation.

LAIAC is a service organization. All efforts are made to perform services for the school, community and the state.

The supervisor of industrial arts education for the State Department of Public Instruction would be an excellent person for you to contact. He probably would be able to inform you of other industrial arts teachers who have an interest in industrial arts clubs and would like to help you. We would like to take this opportunity to offer you the service of our supervisory staff from the Louisiana State Department of Education. It is quite possible you could get a company to sponsor our trip to your state if you could get a group of interested industrial arts teachers and supervisors with whom you would like for us to work.

If you could find some way for you and one or two of your students to attend our State Club Convention, we feel sure it would give you a complete concept of the importance of industrial arts clubs. Let me present to you the procedures you should follow when affiliating with AIASA:

(1) Student club year is from September 1 to June 30.

(2) New clubs may affiliate on any date, but will expire on June 30 of that year. Requirement: one sponsor and five or more members.

(3) Clubs wanting renewal must meet a deadline of October 15. (Extended deadline is November 15. After this date the club will be termed "inactive" until the student club coordinator has received notification of either renewal or termination.) Renewal requires: one sponsor and five or more members.

(4) The club, new or renewal, shall receive club materials.

Mr. Murphy is executive secretary of the Louisiana Association of Industrial Arts Clubs, State Department of Education, Baton Rouge, Louisiana.

Club public relations—state and nation

Eli E. White

Club public relations on the state level is the first topic for our consideration. Before a well-coordinated PR program can be effective throughout a state, a coordinator at the state level should be appointed for industrial arts clubs. This was recommended at the Las Vegas convention in 1969. Only five such persons have been appointed thus far.

This person can be a club advisor/instructor, a supervisor in the state department, or anyone in industrial arts education on the secondary level. The significant requirement is that whoever the individual, he must be enthusiastic about student club work, and be ready, willing and eager to contribute a considerable amount of time without extra remuneration. This individual must live, think, breathe and effervesce his desire for success of the program.

The results of any movement are in direct proportion to the ability of that movement to mobilize its entire membership in constant propagation of its beliefs and objectives. Thus it follows that the various elected or selected coordinators must spearhead this movement.

The first effort of the coordinator is to get all existing local clubs properly organized and affiliated with the state and national associations. Next, he must make a concerted drive to get new clubs organized throughout the state, and of course affiliated with the state and national organizations. The old adage "strength in numbers" may be old saw, but it is quite true in this situation. This is a big job for each of these persons to do. But it must be done. Persistent salesmanship is necessary to sell school boards, superintendents, principals, teachers and students. Yes, you must include parents, PTA's and others. And don't forget sponsors - local merchants who sell school supplies and equipment as well as local industry, civic clubs, etc. Local news media should never be neglected, as they can be a terrific motivating force in the community. Once the local community is behind the idea and willing to cooperate, the rest is relatively easy.

At first there may appear to be resistance to the affiliation with the state and national organization, and this may be natural. It is difficult for them to envision the joining for "good of all". Here again, the coordinator must have at his fingertips the objectives of the state and national organizations, the benefits derived and the advantages of belonging to them. He must know what states have good programs and how they have grown, what methods they used to develop and expand, and other pertinent information of each as examples and guidelines for the prospective local clubs.

After affiliation has been worked out for clubs on the local level for the state and national organizations, projects such as the Louisiana and Texas State Associations undertake each year should be initiated; Awards for Outstanding Club and Sponsor of the Year, awards for best scrapbook, best parliamentarian, best public speaker (encourage topics concerning industry - research and development pertaining to industry), school display and best project in a Craftsman's Fair in the various areas of industrial arts. Too, a project might be developed pertaining to a local industry showing the organizational structure of the industry and miniaturization or schematic of the plant showing conversion of raw materials to finished product.

Naturally, publicity of these events announcing what and where, who is participating and other information beforehand - followed by announcement and pictures of the winners with their projects - is a must.

A newsletter, either monthly or bimonthly, containing club news around the state should be distributed from the coordinator's office. This is a big task, requires a lot of time and ingenuity; but once begun and "local correspondents" are selected to feed information and pictures, the difficult part is over. You will be surprised at the satisfaction derived by all concerned when this is accomplished. We must prove to people that industrial arts is important, that it does contribute vitally to the educational development of every student. This cannot be done on a casual approach; it must be dynamic.

Sponsors were mentioned previously. I would like to take a minute or two to discuss this excellent resource of assistance. Lions Clubs, Civitans, Rotary and Chambers of Commerce are a good bet. Then, too, the local, state and national vendors of school supplies and equipment, publishers and news organizations (newspapers, radio and TV) will usually come to your assistance if properly approached. They will usually help with prizes and funds. But, I repeat, they must be "sold" on the idea, not high-pressured.

I would like to mention the State Department of Trades and Industry as a good source for assistance. And by all means they should be informed of the total industrial arts program in the state. I have found in Georgia that this office has helped us in many ways, both directly and indirectly. After all, their function is to attract industry to the state, and I know industry today is looking for communities with excellent educational programs.

They too can help you in their publications, in their speaking programs and even with roadside billboards. What better program in education is more closely associated with industry than industrial arts? Need I say more?

Club public relations on the national level is the second and last topic. This level of PR is the responsibility of the club coordinator in the national office, and of the public relations committee. The AIASA coordinator oversees the following: distribution of AIASA Scene, filling requests for club charters, membership cards and other paraphernalia and the annual AIASA convention (as co-chairman with the Student Club Committee Chairman). The public relations committee handles the writing of articles on club work for (1) house organs (like Power Tool Instructor), (2) trade magazines (School Shop and IAVE), and (3) professional journals (Journal of Industrial Arts Education).

The AIASA Public Relations Committee had as its members this past year W. A. Mayfield, Texas; LaVern Korb, Wisconsin; William Faver, Texas; Andrew Gasperecz, Louisiana; Bruce King, Montana; Bill Elrod, Kansas; Harry Slack, Illinois; Hank Newberry, Arizona. This represents a good geographical cross-section of the country and a cross-sectional view of industrial arts club thinking. A sampling of articles covering AIASA activities is as follows:

(1) "AIASA - Its Purpose"
(2) "LAIAC - What It Is"
(3) "Affiliation of Texas & Louisiana Clubs"
(4) "IA CLUBS - How One Works"
(5) "IA Club Sponsor's Purpose"
(6) "How IA Clubs Help Total Program"
(7) "It Means Something"
(8) "Drop-Outs and Industrial Education"
(9) "A Club Public Relations Tool"
(10) "Rounding Out Club Meetings"

The PR committee prepares, in conjunction with the AIAA Publications Committee, items such as a brochure explaining AIASA's program and purpose. The net effect must be more advisors, more student clubs, more participation, more enthusiasm.

Industrial arts clubs can be the heart of our industrial arts curricula. The task, then, of the AIASA is to bring to the public's attention the contemporary aspects of industrial arts as the curriculum area orienting students to our technological society. The benefits will be manifold for students, instructor/advisors, schools and communities across America.

Mr. White is with the Atlanta, Georgia, Public Schools.

Club public relations and the community

Tim Beron

Speaking as a national officer of the AIASA, I feel the next two or three years are going to be very critical years in the growth of our organization. Without aggressive promotion on national, state and local levels, our organizational membership may be severely jeopardized. Our role must be always that of promoting good public relations between the organization and community we live in.

The industrial arts organization needs to maintain its public image just as much as any other organization which has beneficial purpose to the community.

Without a club acting as a public relations tool, the public forms opinions only on the basis of what is discussed in the home between students and parents, or relatives and friends. It now becomes apparent how important the role of the organization is. Using the public as a direct line of communication from the school to the parents, we now can effectively sell the program by giving them a true picture of what knowledge and skills the student has learned.

A challenging program in industrial arts within the school is, in my estimation, the greatest factor in promotion of the program. You must have a good program to promote. The local teacher or teachers are the people in the community substantially qualified to set up and direct the local program. The program is only successful if the instructor keeps in mind his purpose, and the nature and overall scope of his program. Once the instructor has established an effective industrial arts program that is challenging to the student, it then becomes a continuing job to communicate to the public what he is attempting to do. And who is the public? The public are the people in the community, be it parents or industry. This is where I feel the local industrial arts club enters the picture.

Today I would like to discuss some specific public relations techniques in dealing with parents and the general public.

First, in dealing with the methods of public relations between the club and the general public, one can use the mass media of communications, such as newspapers, radio and television. We have many articles published in local papers and magazines. Our organization's local reporter writes articles for our national paper, The Scene, the community paper and the area papers.

As I previously mentioned, we make use of radio and television. After last year's convention at Las Vegas, my sponsor and I appeared on our local television station promoting the AIASA to the public. We had information on activities at the convention, and many slides on the exhibits which were on display.

At our school we also have annual exhibits of work done. We call these exhibits Career, Demonstration and Contest Nights. We also have open house and community option programs.

Our annual exhibits show work in various fields for the public to view, with an explanation of what knowledge and skills have been learned by the student. We usually have this set up in our school on a weeknight nearing the end of the year. This way the students have plenty of time to bring their projects up to perfection.

On Career Night we invite representatives from post-high school institutions, industry and labor to talk with the parents and students. They explain the various opportunities open to the student and how they may enter a particular field.

On Contest and Demonstration nights, we have informational talks carried out by students for parents. Here the students get the chance to teach the public what they know and have worked so hard to learn.

The industrial arts club is also a tool used in communicating with industry and telling them our story. Some specific functions which can promote public relations between the club and industry are field trips to area industries. This year, over our Christmas vacation, we took a trip to the IBM plant at Rochester, Minnesota. It gave our students an opportunity to see and talk with professionals in industry. We use professional people from industry as critics on work done in the industrial arts program. They serve as judges in evaluating student work.

Teachers and students try to engage in community activities, such as religious or community projects. These interests depend greatly upon professional and family responsibility. We have inter-organizational activities with the school, such as our annual dance with the FHA. Cooperation between our organization and other school and community clubs is stressed.

There are many other methods of promoting our work to the public; we have only touched on a few. Some people feel we are just after publicity, but we are actually trying to explain to the people the importance of industrial arts and the role it will play in the life of a student. New developments in the various fields make it mandatory that we tell the story to our students upon entering these fields. Not only are we helping the student, but we are also justifying new or additional facilities for our department in this period of inflationary taxes.

In summary, remember these points:

(1) Communicate with the public by mass media such as papers, radio and television. Inform them of our progress and of what we are attempting to do.

(2) Make use of public exhibitions, demonstrations and contests whenever possible.

(3) Point out and explain to students and parents careers in the industrial fields, by field trips, speeches from industry itself, and the use of professionals as program critics.

(4) Last, conduct worthy social activities in conjunction with other school organizations, community clubs and church groups.

May I leave you with this reminder: The public image of an industrial arts program depends upon the personal images the teacher and student project through their participation in various school and community activities.

Mr. Beron, a student at Bangor (Wisc.) High School, is completing a term as treasurer of the AIASA.

Club public relations—state and nation

Bruce King

Club public relations on the state level is the first topic for our consideration. As I see it, before too much PR work can be done on the state level, each state is going to have to appoint a state coordinator for industrial arts clubs. This was recommended at the Las Vegas convention in 1969. Only five of these persons have been appointed so far. This person can be a club advisor/instructor, a supervisor in the state department, or anyone in industrial arts education on the secondary education level. The significant requirement is that whoever the individual, he must be enthusiastic about student club work, and be ready, willing and able to contribute lots of time without remuneration. I submit that the success of any movement is in direct proportion to the ability of that movement to mobilize its entire membership in constant propagation of its beliefs. The various elected coordinators, then, must spearhead this movement. The first job for the newly-appointed state coordinator should be seeing to it that all local clubs are affiliated into the state and national associations. The old adage "strength in numbers" may be trite, but it is nonetheless true in this situation. This is a big job for each one of these persons to do, and it will take a lot of selling on their part. Adults and students have a tendency in many instances to resist giving money and/or subordinating themselves to a larger organization. It is difficult for them to envision the abstraction of joining for the "good of all". After affiliation has been worked out for clubs on the two upper levels, projects such as the Louisiana and Texas State Associations undertake each year (outstanding endeavors in this line) should be initiated: Awards for Outstanding Club and Sponsor of the Year, awards for best scrapbook, best parliamentarian, best public speaker, school display and best project in a Craftsman's Fair in the various divisions of woodworking, drafting, metals, etc. A newsletter, either monthly or bi-monthly, containing club news around the state should be distributed from the coordinator's office. This is a big task for us. An observation over the years in my work in education reveals that people are bombarded from all sides by the various media. The thing we must do is to put our story before the people over their morning cup of coffee, or elsewhere, and prove to them that we have something important to say on behalf of industrial arts clubs.

Club public relations on the national level is the second and last topic. This level of PR is the responsibility of the club coordinator in the national office, and of the public relations committee. The AIASA coordinator oversees the following: distribution of AIASA Scene, filling requests for club charters, membership cards and other paraphernalia, and the annual AIASA convention (as co-chairman with the Student Club Committee Chairman). The public relations committee handles the writing of articles on club work for (1) house organs (like Power Tool Instructor), (2) trade magazines (School Shop and IAVE), and (3) professional journals (Journal of Industrial Arts Education).

The AIASA Public Relations Committee had as its members this past year W. A. Mayfield, Texas; LaVern Korb, Wisconsin; William Faver, Texas; Andrew Gasperecz, Louisiana; Bruce King, Montana; Bill Elrod, Kansas; Harry Slack, Illinois; Hank Newberry, Arizona; and Samuel Powell, Georgia. This represents a good geographical cross-section of the country and a cross-sectional view of industrial arts club thinking. A sampling of articles covering AIASA activities is as follows:

1. "AIASA - Its Purpose"
2. "LAIAC - What It Is."
3. "Affiliation of Texas & Louisiana Clubs"
4. "IA Clubs - How One Works"
5. "IA Club Sponsor's Purpose"
6. "How IA Clubs Help Total Program"
7. "It Means Something"

8. "Drop-Outs and Industrial Education"
9. "A Club Public Relations Tool"
10. "Rounding Out Club Meetings"

The PR committee prepares, in conjunction with the AIAA Publications Committee, items such as a brochure explaining AIASA's program and purpose. The net effect must be more advisors, more student clubs, more participation, more enthusiasm.

Industrial arts clubs can be the heart of our industrial arts curricula. The task, then, of the AIASA is to bring to the public's attention the contemporary aspects of industrial arts as the curriculum area orienting students to our technological society. The benefits will be manifold for students, instructor/advisors, schools and communities across America.

Mr. King, who teaches at Hamilton (Montana) High School, is chairman of the AIASA Publicity and Public Relations Committee.

Public relations and the community

Walter Comeaux

In order for a baby to grow, it needs the proper foods, and, most important of all, it needs attention from its parents. In order for an organization to grow, it requires the proper nutrament, such as leadership, devotion and, most important of all, the support of the people. The only way that people will support an organization or cause is if they learn about it and its purpose. This is done through public relations.

Public relations is a vital asset to the growth and operations of an organization. It is necessary that the organization as well as its functions be made known to the people. If an organization does not expose itself, it will fail to gain the people's support. This may sound a bit irrational, but think about this for a moment: The people have the money and the good intentions; all they need is to be prompted. In other words, the people will usually support a cause that is worth while. It is a fact that an organization needs funds to operate with any type of efficiency.

An organization needs more than financial support. It needs support of its service projects for the community, such as, sponsoring safety campaigns, fire prevention activities, community affairs, etc.

The people of the community should be made aware of these activities by publication on television, radio and in the newspapers. It is possible that publicizing a club's activities will increase many people's support. It might even cause new clubs to become organized as well as an increase in membership of clubs presently organized.

Unfortunately, there is only a small minority of people who realize the importance of industrial arts clubs, and it is up to us, the members of this association, to emphasize the necessity of these clubs. The only way that this can be done is through public relations. Public relations is one of the determining factors in the growth and prosperity of industrial arts clubs.

Mr. Comeaux, a senior at Acadiana High School, Baton Rouge, Louisiana, is the newly-elected president of AIASA.

IACC reports to the members

Terry Pemberton

At the annual AIAA convention in Louisville, the Industrial Arts College Clubs made a concerted effort to revive their lagging organization, and they achieved a remarkable degree of success. Following is the report of their business meetings, in condensed form.

The new officers of the IACC were installed into their respective offices on April 9, 1970. The officers are as follows:

President: Stanley Bishop, Sam Houston State University, Huntsville, Texas; Vice-president: Rudy Cantu, Southwest Texas State University, San Marcos, Texas; Treasurer: Wynn Gustafson, Northern State College, South Dakota; Corresponding Secretary: J. Steve Keeny, Fairmont State College, West Virginia; and Recording Secretary: Terry Pemberton, Northern Arizona University, Arizona.

With the installation of the new officers, the business meeting followed, and discussion was led by Mr. James F. Snyder, Chairman of the Advisory Committee of the IACC. The discussion was based on the subject of setting the membership dues for the following year. A problem was brought out by several of the club advisors that attended the meeting, this being, what will be the benefits that the IACC members will receive from the set dues? With this question in mind the meeting was recessed until the following day.

The following day the IACC officers and fellow IACC members opened the floor for discussion on the criteria to be established for benefits to IACC members across the nation in the following year, 1970-71. Discussion continued on the subject for approximately two hours, with some very wise suggestions, but no direct introduction in the form of a resolution was arrived upon. A resolution committee was chosen by the vice-president, Rudy Cantu, asking for two volunteers from each college club present at the meeting to help this committee in working out and writing a resolution to be presented at a special meeting the following day, April 11th. The meeting was then recessed.

On April 11th the meeting was called to order, asking for the reading of the minutes of the previous meeting, and any old business to be taken care of. New business was then called for, and a resolution by Charles D. Buckheim, Chairman of the Resolution Committee, was introduced. A vote was asked for in passing the resolution as read:

The four major goals in the resolution are as follows:

(1) To provide a yearly membership certificate on initial membership.

(2) To provide to each of the members a subscription to The Journal of Industrial Arts Education. The corresponding secretary shall provide the distributor with a mailing list of the active IACC clubs.

(3) A program will be sponsored by the IACC to be presented at the 1971 Convention.

(4) To utilize the provided space in each Journal of Industrial Arts Education for such information as:

a. club activities

b. national convention activities

c. state convention activities, or other news of interest written by IACC members.

In order to meet these set goals, a budget along with the set dues of the IACC at $3.50 per member was proposed and presented to the Advisory Committee of the IACC. A detailed report on these goals will be issued in the future.

The resolution was passed by a majority vote. Without any more new business being introduced, the meeting was adjourned.

The method by which a local club may become a member of the IACC is as follows:

(1) A required minimum number of members that may join will be ten (10).

(2) The local club must submit a copy of its constitution to:

Steve Keeny
Corresponding Secretary, IACC
Fairmont State College
Fairmont, West Virginia 26554

(3) The dues will be $3.50 per member.

It is hoped that the goals for the following year will be fulfilled to create a stronger national organization. The officers of the IACC would greatly appreciate full cooperation from both local and state clubs in order to promote a long-needed leadership in the IACC.

As another step in promoting this leadership, a program committee is charged with the responsibility of developing presentations for IACC for next year's AIAA convention in Miami Beach. The committee has 20 members, as follows:

Wayne Scrudder, chairman, Central Missouri State College; Rudy Cantu, Southwest Texas State University; Steve Keeny, Fairmont State College; Stan Bishop, Sam Houston State University; Terry Pemberton, Northern Arizona University; Charles D. Buckheim, Central Missouri State; Charles Woodall, Central Missouri State; Ted Morgan, Northwest Missouri State; John R. Hardwick, Northwest Missouri State; Bob Hiltner, University of North Dakota-Grand Forks; Bob Christopher, University of North Dakota-Grand Forks; Duane Jungely, University of North Dakota-Ellendale Br.; Gary German, University of North Dakota-Ellendale Br.; Danny Conaway, Fairmont State College; John W. Phillips, Fairmont State College; Beth Crawford, Indiana State College; Ronald L. Bush, Indiana

State University; James F. Griffin, University of Missouri; David St. John, University of Missouri; and Delmar E. Johnson, Kearney State College.

Mr. Pemberton, recording secretary for IACC, is a student at Northern Arizona University.

Can we correct offenders without stated goals?

Garland S. Wollard

Who enjoys participating in or observing athletic events? Why do these events have to employ referees or officials? You know the answer to these questions as well as myself.

Picture yourself in front of the TV set on a Saturday afternoon watching a football game. What do you know about the game before it starts? First, there will be eleven players on each team. The rules of the game are clearly understood by the officials. The number of points to be counted for each type of goal achieved has been predetermined. The dimension of the playing field is carefully measured, and critical distances are well-marked. As the game is played you enjoy the event because each team has its task clearly defined: Win the game! This is the measurable outcome to be achieved.

Now, let us suppose there were no rules for scoring the game. The amount of each score would be determined by the officials or the umpire. Team X crosses the goal line. The officials consult one another and it is announced that Team X will receive 3 points. Then on the next series of downs Team Y scores and the officials decide to award Team Y seven points. What would happen if this were done? The fans would probably riot, tear down the stadium, fights would break out, and the officials would be murdered.

Let us examine a more real-life situation. Suppose you are visiting in a foreign country and a native friend invites you to attend a Fing Ding match. You haven't heard of the game before. You have no idea what it is all about. The teams come out on a circular field marked off with small semi-circles that appear to be randomly located on the field. Eight men and three women come out on the field. The women are wearing swim suits and leading a giant German shepherd dog. The men are clothed in deep-sea diving gear and carrying flashlights. Suddenly, an eagle swoops down over the field and one of the men hits a dog over the head with a flashlight. The fans go wild! Next a man takes a dog away from a female participant and ties the dog to a stake near one of the semi-circles. The fans boo, shout and stomp their feet. You turn to your friend and ask, "What in the ---- is this game all about?" He shrugs his shoulders and replies, "It is a very complicated scoring system, and no rule has been reached about who scores a point." At this moment the participants all sit down and all activity ceases. "When will play resume?" you ask. Your host announces that no limit has been established. After 30 minutes of watching no activity, your wife turns to you and says, "Let's go somewhere for a drink."

In other words, without stated rules and goals, a game becomes an unpredictable series of activities.

My challenge to you is that offenders cannot be corrected with any degree of predictability without stated goals. To establish goals requires input data, feedback data, interpretation of data and implementation of program to support the goals established as a result of data studies. Goals now become the measuring stick of outputs. Without a measurement of outputs, the input data and supportive programs become an unpredictable series of activities, because we never know when we have scored.

Can correctional goals, or for that matter educational goals, be stated in measureable terms? Absolutely! Like the football game, there are numerous activities that are not goal-oriented or measured, but the final outcome is based on measurable activities and goals. So, we first state those goals that can be measured. Other non-measurable activities will have to be studied and evaluated at length before a measurable unit can be assigned with a degree of confidence.

Now, it is time to become specific. What do we know about the people who are in prison? They are mostly high school drop-outs, unskilled, unread, poor readers, lack self-confidence, come from backgrounds of poverty, have negative feelings toward society, are resentful of authority, and are accused by the prison staff of being unmotivated. These are the inputs. You can add to this enumeration; it is an open-ended list.

What are the programs designed to overcome these behavioral deficiencies? Academic education, industrial arts, vocational training, on-the-job training, group counseling and therapy, punishment, institutional work details, religious program, medical and dental treatment, work or study release and community treatment centers. You can add or subtract from this list; it, too, is open-ended.

Now, the big question to be answered is: In order of priority, which of these programs is most effective? Wait, don't start to answer. Which of these is most effective to serve what end?

What ends do we want served? Good adjustment to the institution? Dependable workers in prison industries? A good typist to serve as an office clerk? A good reader to work in the prison library? Or is the desired end to work yourself out of a job? I hope this last statement is your number one priority.

The number one goal should be that any person leaving prison will have one crime-free year after release. Measurable? Yes! Reasonable? Most certainly. Valuable to us? Indeed! Because we would know the first year returns, we could analyze in depth what caused their return, and then determine where our program failed. Remember, people don't fail, it is the program that fails. People die of cancer because medical science hasn't found a cure, and, as a result, we don't blame people for dying of cancer.

A point of follow-on about goal number one is in order. Why one crime-free year? Why not two, five, ten or a life of non-criminal involvement? The answer? Because we need the feedback data now. The sooner the better, so we can start to change our program. To wait five or ten years will allow programs to become set into concrete, and any changes would require a major upheaval in staff and institutional policies.

Goal number two: Every person leaving prison will be able to read at the sixth-grade level. Measurable? Yes. Practical? Certainly. Reasonable? Indeed. This is a goal essential to the survival of any person in our highly-technical, service-occupationally-oriented society. The emerging fields of employment are in the service fields of health, education, welfare, sales, repair of appliances. The environmental fields of waste disposal, water and air purification, safety standards and urban rebuilding will be the big employers in the seventies. Ability to read is an essential basic requirement of these occupations.

You will recall the goal that everyone leaving prison will be able to read at the sixth-grade level. You might ask then: What about the unmotivated, the slow learner, the emotionally and physically handicapped individuals? Are these to be included? Absolutely! Unless we meet the challenge of these groups, programs will never be developed to solve their problems. I'll never believe that program experimentation should cease totally, because research on reading ability and techniques has not scratched the surface of what causes reading problems. Recall at one time in the 19th century that debate continued long and hard to close the patent office because there was nothing left to invent. Thank God for a few farsighted individuals who prevented their fellow men from committing a near catastrophe. We can't afford to hide behind a cloak of ignorance.

Goal number three: No person with average or above ability should leave prison without a GED completion. Measurable? Yes. Valuable? Certainly. Practical? Indeed! It is just as criminal to let a person with ability leave prison without a GED completion as it was for him to come to prison in the first place. He won't participate in the program. He refused to come to school. Who is to blame? Let's say it is the program's fault. Perhaps he doesn't like the little-boy lectures on the Civil War, the nonrelevant math problems, the Moby the Whale reading lessons. Or, he may need an external goal established to start the wheels in motion. How about an award of $50.00 for a successful GED completion? The taxpayers annually pay thousands of dollars for the prisoners' keep. Is another fifty dollars' worth of investment to achieve a worthwhile, practical, valuable goal worth the risk?

Goal number four: No unskilled person will leave prison without the job skills to earn a minimum of $2.50 per hour. Measurable? Yes. Practical? Certainly! Valuable? Indeed!

This goal should need no elaboration. Of course, if you believe that released prisoners can live without food, shelter, clothing, health care, family responsibilities, then we can forget the need for this goal. What few studies have been done on this subject of jobs have made one point clear: Released offenders do not want to work at dead-end jobs. Really, now, who does want to work in dead-end jobs?

Goal number five: No person in financial need will leave prison without a career-oriented job. When prison educational and training programs reach a high degree of integrity and quality, employers will seek out the trainees. No employer is searching for semiskilled, poorly motivated workers. Can we program for this goal? Yes! If technical schools can teach high school drop-outs to be qualified employees, they why can't we?

The five goals just stated are only a beginning. As other corrective programs are developed to a measurable point, they should be added to the list. One or a dozen goals does not guarantee success. Stated goals are measurable outputs to provide feedback for you to evaluate and, if need be, to change or modify the program. With this feedback you can justify budget increases, identify manpower needs, design functional facilities, and be the first in prison administration to break the "frustration barrier".

If these goals are unrealistic to you, please feel free to draw up your own list. But please don't state, "Our goal is to improve his attitude." This isn't measurable, and the feedback will not be of practical value. If you can't measure the stated goal, then don't design the game so that each score is determined by a group of referees on a no-rule basis. The price of correcting the offender is too costly for us to play the game without a statement of rules and goals.

Dr. Wollard is director of education, Federal Bureau of Prisons, Washington, DC.

An integrated approach to industrial literacy

Paul Richard Thomas

The Robert F. Kennedy Youth Center's industrial arts program is based upon an operant conditioning model foundation coupled with the integrated curriculum approach and individualized instruction. I would like to acquaint you with its rationale rather than with its course content, since the philosophical basis of a curriculum controls its approach to content.

As you are aware, the students which our institution receives are, by-and-large, academically retarded and industrially illiterate. But these students do comprise a normally distributed IQ population found in any public school. Their ages range from 14 through 21, and the average length of stay is ten months. Essentially we have the same human abilities available to us as any learning system.

However, few of our students have any conception of a company, corporation, vocational clusters, technological flexibility, automation, or operation of this or any other economic system.

Wage levels, union contracts, crafts, quality control are words from a foreign culture.

Mechanical aptitudes or experiences are nearly non-existent.

Any attempt to lecture about the need for education as a means for earning greater future riches is an abstraction beyond their caring. So is shop instruction designed as training for better jobs with better vertical mobility.

Add to this picture a well-developed defense against teachers, instructors, classrooms or shops--a damaged self-image. This image has resulted in the student's developing a set of well-established unacceptable deviant behavior patterns.

Among these unacceptable patterns are: escape responses to the routine of work, inability to withstand deferred rewards, distorted interpersonal relationships, the lack of self-discipline that is required to succeed at long-term goals and little interest in or understanding of middle-class virtues and goals. These behaviors make most of our students unemployed or unemployable--even if they possessed the sophisticated technical skills required in most of today's job market.

We see living proof of the old adage that failure breeds failure. In so many words--chronic failure is self-reinforcing.

Now we, as a staff of professionals attempting to prescribe for a student an individualized course of objectives or goals, have come to see this as the gut issue: To any given student, what is the nitty-gritty? What is relevant to this student? What turns him on? How do we get into his skull--string him out--and put him back together.

Well, our beginning is a complete test profile which includes academic achievement scores, maturity level, IQ, general aptitude profile and personality inventories. These give us partial answers to the question, does this student need immediate shop training—with what degree of supervision? Or does this student need academic tasks at which he can succeed? When does he need them--before shop training or with shop training? In many cases, students who have had long records of school failure, when able to work on programmed units near their level of achievement and at which they do succeed, are turned on to our entire program. There seems to be a definite value in a student succeeding at a task which has in the past caused him much anger and shame. A new self-image begins to develop as the result of this success.

However, I hasten to add that our students' initial successes are not based upon easy or set-up tasks. Cheap success is phony, and these students can spot a phony a mile away. A careful staff survey of both technical and academic programmed texts available has produced much material which is of high interest--low vocabulary technically-valid type.

The student, however, provides us with the most important piece of information: what does he want?

Now, once we have the student's interest warmed above the chill level, there enters a small student awakening and he becomes vulnerable to our program.

What then occurs is that the student attempts to behave to achieve continued success. These behavior approximations have required all our staff to become sensitive to these attempts and reward them immediately. In so many cases the students try to reach us in such subtle ways that we still miss them, but our trying seems to inspire most of our students to keep trying and, as they receive increasing tangible and intangible rewards, they become more sensitive to acceptable behavior patterns and consciously seek rewards. The system of rewards has had to be flexible in order to insure that the rewards are in fact rewarding to our students. There another major rationale of our program is utilized: Flexibility.

Flexibility is changing a student's schedule to reflect a new set of needs or desires, or designing a schedule to give a student who has been a consistently high achiever a maximum free-time schedule. Or flexibility is designing a schedule to give a student a total industrial arts program or a college schedule or a total remedial education schedule.

In fact we still are not running out of individualized schedules and, as many of you who have designed a curriculum know, this flexibility can be a paper-work nightmare--but to do less would be a professional cop-out and, more damaging, perceived by the students as a type of hypocrisy with which they are all too familiar.

Our reward system also utilizes a system of cash payoffs for both achievement and acceptable behavior, plus a system of deferred rewards in the form of a structured three-level social system.

Each level has increasing privileges and responsibilities. The lowest level--a trainee--has the fewest privileges through an apprentice to the highest level--honor--which has the most privileges and personal privacy in the form of a private room and lavatory, plus complete discretion in clothing.

The cash payoffs are based upon a student's satisfying specific school goals which are stated in terms of observable behavior and required levels of performance. Each student has a copy of the course's requirements, so he knows what he is going to be required to perform.

As hateful as it may be for some of us to admit, the Center's students exhibit chronically erratic behavior patterns which have not been helped--in fact many have been hurt--by the public school curricula to which they have been exposed. Therefore we have rigged--so to speak--the school program to give the biggest tangible payoffs to the school. Thus institution-wide the school is the only training program in which the student can earn hard cash, and his level promotions also depend in large measure upon a successful school record. Another basic rationale of the Youth Center's program is student responsibility.

Since--theoretically at least--the main person responsible for learning is the learner, we have streamlined the contract grade system to fit our students' needs and program design.

Each teacher, whether academic, related shop instructor or shop instructor, establishes a contract with each student. The contract covers a specified amount of time, an acceptable level of achievement, specific tasks which the student must complete and the cash payoff for successful completion. The contract is a mutual agreement and requires a student commitment. This approach has forced each staff member to write a complete course program in order to have course units and performances available immediately.

This program is not an outline, nor a set of glittering generalities moving through a heaven of vague goals. The success of our contract system depends upon the student being able to know what he is to do, how well he must do it, and under what conditions he must perform the required task or tasks, and on the teacher being able to observe those required behaviors.

To this end every course is broken down into modules, which cover a large area, say, Ohm's Law; milestones a smaller area, say, voltage; and performance objectives like series voltage drop calculations.

Each performance objective states what is to be done, with what it is to be done, how well it must be done and is stated in terms of observable behavior.

In addition to having a well-structured course on several levels of difficulty or levels of technical competency, and on student contracts, we individualize the pace or amount of achievement a student must complete.

As you all know student pace is not only a function of motivation but also includes some mastery of basic reading and arithmetic skills.

As our program is designed, the student can set up a shop schedule which we know will make demands on his academic skills that he is not capable of meeting.

When the student runs into his inadequacies he sees first-hand the need to master basic academic goals so he can go on to learning more sophisticated skills and operations in a technical area or areas. It's his problem and he has to solve it.

Pace also means that each course has to be structured so that an exceptional student can finish as rapidly or as slowly as he is capable. Since the Center's program relies wherever possible on programmed instruction, this is a built-in capability.

To prevent the technical and academic areas from becoming isolated from one another on the staff level, materials are utilized which are technical in the academic areas, and also reports, research papers and vocabulary list assignments are coordinated.

To fill out the concepts of job structures, unions, organizational structures, manufacturing processes, product development, market operations and the concepts of supply and demand, a related concepts class and cultural or life class are made a part of the student's schedule.

Summing up: Our program attempts to use an individualized curriculum based upon the operant conditioning model of behavior modification, placing the responsibility for learning on the student, where it belongs.

While recognizing that our program has certain aspects which are unique to our institutional setting, we have attempted to design a curriculum which centers on helping a person, not an unidentified mass of students, and this is a goal all professional educators are attempting to reach in order to become more effective in helping a student to reach his potential.

We do not reinforce the quite unobtrusive student by social promotions. We make demands on the student to perform at his level and his speed. We then see to it he is rewarded for his efforts.

Each student must be assured that he is a person worthy of attention and training, that he can succeed in society, that he need not join a minority culture to gain recognition, that he is a man and doesn't have to prove anything, that he is not a victim of unseen forces over which he has no control or understanding.

Without a student firmly believing in his personal worth, all the technical training humanly possible won't count for a grain of sand. In the final analysis we must make a human response to a person in need of understanding and training.

Mr. Thomas works with the Robert F. Kennedy Youth Center, Morgantown, West Virginia

Rehabilitating public offenders through an industrial arts program

Joseph H. Pierce

"Two inmates peered through bars;
One saw mud, the other stars."

The Vocational Rehabilitation Program, one of the oldest grants-in-aid programs for providing services for individuals, had its start when President Wilson signed the Smith-Fess Act in 1920. In the 50 years since the start of the program, its basic concepts have continued mainly unchanged, with substantial enlargement in scope of effectiveness in legislative authority in 1943, 1954, 1955 and 1968.

Vocational rehabilitation is a combination of services provided to a physically or mentally disabled person, as needed, to prepare him for employment and productive useful living. These services are provided to disabled persons whose disability is a vocational handicap in that it interferes with acquiring or keeping employment.

The essence of the program is to marshall all resources, in a coordinated way, to bring the disabled person to his best functioning level.

The three basic criteria for eligibility for rehabilitation services are:

(1) There must exist a physical or mental disability.

(2) There must be a substantial handicap to employment.

(3) There must be a reasonable expectation that vocational rehabilitation services may render the individual fit to engage in a gainful occupation.

The types of impairments considered suitable for service have broadened from the earlier emphasis on orthopedic, visual, hearing, speech handicaps; mental retardation; mental illness; and the other more traditional concepts of disability. Included now are juvenile delinquents, public offenders, alcoholics, poverty-stricken high school drop-outs, underemployed, disabled, housewives and others who possess a physical or mental condition which materially limits, contributes to limiting, or, if not corrected, will probably result in limiting an individual's activities or functions. Also included are behavioral disorders characterized by deviant social behavior or impaired ability to carry out normal relationships with family and community which may result from vocational, educational, cultural, social environmental or other factors.

The effects of extended unemployment, institutionalization, as in the case of public offenders, job obsolescence and cultural deprivation, may be a basis in determining the vocational handicap.

Barriers to reform. The notion that imprisonment corrects criminals is a surprisingly recent idea. Before the 18th century, prisons were mainly used not to punish but to detain the accused or, for example, to hold hostages till he paid. To combat crime, Europeans castrated rapists, cut off thieves' hands, and tore out perjurers' tongues. England boasted of 200 hanging offenses. When crime still flourished, reformers argued that capital punishment was not a deterrent. In 1786, the Philadelphia Quakers established incarceration as a humane alternative. Seeking penitence (source of the word penitentiary), the Quakers locked convicts in solitary cells until death or release. So many died or went insane that in 1825, New York's Auburn System introduced hard labor – and utter silence. Until quite recently, the United States relied almost entirely on the spirit-breaking Auburn System of shaved heads, locked-step marching and degrading toil in huge, costly isolated cages that soothed the public's fears of escapes.

The caging syndrome has crippled US penology in every way. Because forbidding forts refuse to crumble (25 prisons are more than 100 years old), there is often no way to separate tractable from intractable men – the preliminary step toward rehabilitation. Of course, barriers to reform go far beyond the limitations of buildings. Therefore, in 1967, officials within the Kentucky Department of Corrections began seeking a program that would treat those incarcerated at the Kentucky State Reformatory, the largest correctional institution in terms of population, with approximately 1700 inmates. Sixty percent (60%) of the public offenders originate from rural and small community environments, while the remaining forty percent (40%) have urban backgrounds. A substantial number range from 16 to 26 years of age. Only one-half have been convicted of one felony; therefore, it is significant to note that 76 percent have no secondary offenses. Within one year or less, 855 will appear before the Parole Board. A majority of sixty-nine percent (69%) are unskilled laborers.

In summary then, the typical population characteristics of public offenders at the Kentucky State Reformatory in LaGrange reveal a young, rural, unskilled person who is a first offender and has below an eighth-grade education with an opportunity for parole within one year.

The objective is clear. The shortest route back to society as useful, productive citizens for a great many inmates in Kentucky's penal institutions, as well as for those on probation and parole, lies within a *multiphasic* rehabilitation program. The problem of correctional rehabilitation is so varied and complex it can't be solved by one agency alone; it requires an interagency cooperative effort.

An interagency approach. In 1967, an agreement was signed between the Departments of Corrections, Vocational Education and Rehabilitation. This has become known as Operation RESTORE. RESTORE means Rehabilitation and Education of Selected, Trainable Offenders Returned to Employment.

The multiphasic approach, though complex in many areas, has a clearly-stated goal; the Department of Corrections allows the Department of Vocational Education and the

Bureau of Rehabilitation Services to operate as the second and third parties in the agreement. In addition, the multiphasic approach provides for a cooperative agreement that allowed the Bureau of Rehabilitation Services to construct a Vocational Training and Rehabilitation Center in the fall of 1969, at a cost of one-half million dollars. The new facility has a total of 7500 square feet and houses 11 vocational shops. These shops include drafting, typewriter repair, electricity, printing, TV and radio repair, welding, small engine repair, building trades, auto mechanics, auto body repair and vocational meat cutting.

The staff of Operation RESTORE includes a project coodinator, one vocational education principal, one facility supervisor, one clinical psychologist, one vocational evaluator, six counselors and five secretaries.

Unique services. Preparing the inmate mentally and physically is another major phase of the program. This falls primarily on the Kentucky Bureau of Rehabilitation Services. Rehabilitation services to the client include such areas as general medicine, special medical and diagnostic services, psychological services, physical and medical restoration, vocational evaluation, work adjustment, vocational counseling and general counseling. Rehabilitation services also furnish special appliances such as artificial limbs, braces and surgery.

One of the strongest features of the program is the assistance provided by rehabilitation counselors in finding jobs and in setting up on-the-job training programs for those who have served their sentences and leave the institution. The same services are available for the parolee, but through the cooperation of his parole officer.

Vocational rehabilitation counselors, along with the parole officers, take over when the inmate is released from prison – providing job counseling, locating the inmates in jobs and even a place to live if necessary. This service is continued until the inmate is officially released from the program; however, he may return to the program if he needs it.

While inmates at the institution continue to be screened to determine if suitable for the program, new arrivals are screened during the quarantine period. Those selected for the program are assigned to an individually-tailored program of evaluation, vocational education, academic education, or a combination of these services immediately after completion of the quarantine period.

Operation RESTORE extends beyond the bounds of the Reformatory's facilities. The rehabilitation counselors are able to set up on-the-job training programs on a state-wide basis for their clients in private industry, particularly in the small industries. At the present time there are four ex-offenders enrolled in various colleges throughout Kentucky and one in the State of Illinois. Two of the college students have made the dean's list and one has been elected president of his junior class.

Another strong point of the program is the intensive follow-up that is provided for those placed through the efforts of a rehabilitation counselor. The minimum time of follow-up is three months, and the maximum has been as long as two years.

Since the program's inception in 1967 to date, approximately 432 offenders have been referred to Operation RESTORE. Of this number, 241 have successfully been employed, as opposed to 83 whose cases were closed as not rehabilitated.

In closing, I must go back to where I began by saying that what most convicts really need is neither repression nor sentimental treatment as patients, but rather opportunity for restitution through rehabilitation. Never was American prison morale as high as during World War II, when the nation relied on convicts to work so diligently producing almost $300,000,000 in war goods and food. Never was morale so low and fights so rife as when idleness returned after the war. On many occasions, prisoners have fought fire and flood with a zest and courage that amazed and won the communities they saved. As guinea pigs in countless medical experiments, they have voluntarily suffered malaria, cancer, syphilis and other ugly ills for theirs and the public's benefit.

The key is self-respect: prisons are full of men who perhaps above all need a chance to serve society in order to respect themselves. We in the Correctional Rehabilitation Program in Kentucky believe that the men incarcerated within this state can find self-respect through an excellent industrial arts program of training and counseling as we now have in our correctional system.

"Two inmates peered through bars:
One saw mud, the other stars."

Dr. Pierce is supervisor, Department of Education, Bureau of Rehabilitation Services, La Grange, Kentucky.

What is the place for industrial arts curriculum in a correctional setting?

L. E. Jensen

During the last two and one-half years, I have been privileged to serve as the Occupational Research and Development Coordinator for the Federal Correctional Institution in Lompoc, California. In that position, I have spent much of my time in discussion with employment, industrial relations and personnel involved with training in private industry. Geographically, most visits have been made to industries in Southern California, since the majority of our inmates are released to that locality.

It also has been my responsibility to keep current vital statistics on the incoming population and to conduct an occupational follow-up on those persons released to parole supervision from our institution. This is done to help those in charge of the institution's training programs to identify the target population for which training must be provided, and it serves as one means of feedback to determine the results of the training.

Although many of these activities require me to be away from the institution much of the time, it is still quite important to have representatives of outside agencies, both from industry and community training facilities, visit our training programs for the purpose of providing services and suggestions for improving our on-going training programs.

From these experiences and by talking about training with the inmates in our institution, several interesting observations can be made which point out the challenge that we are facing in the field of correctional education. The challenge can be partially met by the application of industrial arts concepts.

The obvious challenge can be shown by a few statistics based on and quoted from the President's Task Force Report on Corrections, published in 1967. The American Correctional System handles nearly 1.3 million offenders on an average day; it has 2.5 million admissions in the course of a year; and its annual operating budget is over a billion dollars. These figures, of course represent all correctional operations which are administered by Federal, state, county and municipal governments. Latest figures indicate that there are approximately 20,500 persons in Federal facilities throughout the United States, and of those there are approximately 5,000 persons under the age of 25.

Perhaps less obvious but more fundamental is the observation that industry is experiencing great difficulty in hiring dependable and loyal employees who will come to work on time; who will report to work on a regular basis, or at least will make prior arrangements when it is necessary to be away from the job; who will put in a full day's work for a day's pay; and who are more interested in career opportunities and advancement rather than in quitting their jobs only to work in a similar position for a little more money with another firm down the street. This is not only true of persons with a criminal record but from the general society as well.

Certainly, it is an important function of industrial arts programs to correct these weaknesses in their graduates. The correct job attitudes and the importance of allegiance to an employer should be emphasized with development of basic skills in any industrial arts program. In many cases, instructors in correctional institutions can most help their graduates to overcome the ill effects of their criminal records in the eyes of their employers, by convincing them to be faithful and dependable employees who will be on the job regularly for the purpose of a full day's work. If an individual can demonstrate such allegiance to his employer upon release from an institution, the fact that he is an ex-felon will become less important.

If we were to select one factor to serve as a common denominator of most inmates in our institution, it would be, in my opinion, their inability to choose and pursue long-range goals. Everything centers on immediate gratification of their wants and desires with little regard of the consequences or the long-range effects of their actions. Therefore, it is very difficult for these individuals to set life-time or long-range goals. Quite naturally, I suppose, their main interest and efforts center on their most immediate problem of making parole or in finding some other means of early release from the institution.

Here again is a situation where industrial arts philosophy and curriculum have applications. Most of the occupational training programs at Lompoc are organized to operate on a half-day class session. With two classes of 10 to 12 students per half-day, it is possible to operate an introductory class during one half-day, and a more in-depth vocational skill-building course the other half-day. The beginning class is strictly an industrial arts class, with the main emphasis on the characteristics of the trade or industry; working conditions and qualifications required; and the steps involved in the career ladder leading to the higher-paying upper management possibilities in industry. Carefully-selected skills and operations are also included in the basic program. On the basis of these skills and facts about the industry, the student is able to make the decision either to continue his training through the advanced program or to terminate at the conclusion of the basic course. The instructor is better able to counsel the student realistically at this point on the basis of the student's demonstrated ability to perform the basic skills. Involvement in the basic program also provides the instructor the opportunity to weed out the individuals who are in the course only to impress the parole board without a sincere interest in seeking related employment upon release. It is the object of this design to aid the student in choosing an occupational goal through his personal involvement and experimentation.

Since one of the principal factors used to classify inmates to a certain institution is the age of the individual, the institution dealing with persons under the age of 18 years releases many individuals who are too young to qualify for skilled jobs. Therefore, the major concern should be in providing their students with a more flexible education to include the application of broad principles and not narrow mechanistic operations. Earl M. Warren suggests, in his article entitled, The Role of Industrial Arts in Tomorrow's Schools, that certain fundamental skills are needed by everyone who aspires to become a truly educated man and to find the place or job in which he can be most effective. He further states, and I tend to agree, that being flexible, being creative and being able to make wise choices are among the important skills required by the liberally-educated person of tomorrow.

From studying many accumulative files of residents in the institution at Lompoc, indications are that a person 18 to 26 years of age has little difficulty in finding employment, but as a person nears thirty he becomes a bit of a burden to the labor market. Representatives of industry have told me time after time that they want young people who have ambition and interest in finding their place in industry, with a general background in their chosen field, and the industry will be glad to provide specialized training necessary to perform the tasks the person will be hired to do.

From these experiences, I have drawn the conclusion that the older a person becomes, the more important it is to develop skills or have credentials required by industry before seeking employment. Conversely, persons under 20 years old should be given a more liberal industrial education which will serve as a foundation for quickly learning the specific skills which are gladly taught by industry itself.

Another important function to be served by industrial arts in the field of corrections is as a motivation for inmates toward academic improvement. I realize that this may be an overburdened theory of traditional education, but since we in corrections are not forced to operate under the imposed restrictions, such as definite time periods for academic and industrial arts study, it is easier for our instructors to tackle academic problems as they arise. We are not forced to require a certain number of clock hours as a term of course completion. Therefore, our shop instructors can afford to spend more time on mathematics or spelling as such problems pop up in the shop than can a public school shop instructor. It is easier then to show the relationship that academic skills may have with practical occupational skills. Thus, inmates' interest toward improving their academic skills is improved by seeing the practical application.

My observations about industrial arts application to the correctional setting to this point have been concerned with what industrial arts can do for the correctional institution. One might also ask, what can the correctional field do for the industrial arts field?

From review of the literature concerning industrial arts research, I have come to the same conclusion as John L. Goodlad, Dean of Graduate School of Education, UCLA, who expressed his views about educational research in the June, 1969, issue of Review of Educational Research: "Researchers know little about what happens in the classroom, how those carefully-developed materials are used or if they are used at all, how conflicts between the ideological curriculum material and the mental curriculum of teachers are reconciled; what reaches the student and what does not; and on and on."

In my opinion, research with practical application can be done best by classroom personnel, and this is an area where we in corrections can be of service to you in other educational fields. After all, where else is there such a large group of students on a

24-hour-per-day standby? We have tremendous opportunity to study both the learner's and the teacher's roles and their relationships to the learning situation. Much has been learned already at Lompoc about how people learn and what the teachers' place should be in the learning situation. So we in corrections do have something to give to the outside field of education in turn for what outside fields have to give us in corrections.

In summary, I have attempted to point out the challenge facing us in corrections and have mentioned some of the places that industrial arts philosophy and programming can be of help to us in meeting the challenge – namely, that the occupational curriculum in the correctional setting should be carefully planned to produce: (1) the thought processes required as a foundation for learning specific skills to be taught by industry; (2) an attitude that will promote allegiance of individuals to their employers; (3) an increased interest in improving academic skills; and (4) the opportunity for individuals to establish personal occupational goals based on their participation in the occupational training program. Due to the relatively short period of time a young man spends in our institution, the emphasis on specific skill building should be decreased, and a liberal technical foundation should be our primary objective.

Perhaps these observations and related applications seem rather obvious, but we would appreciate any recommendations or services that the American Industrial Arts Association can provide. There is much, in my opinion, that we in corrections and you in other educational fields can do for one another, and I am looking forward to a long and prosperous working relationship with the organization.

Mr. Jensen is an occupational analyst, Federal Correctional Institution, Lompoc, California.

Can AIAA expertise and resources enhance correctional education activities?

Kenneth Wayne, Yancey

We in correctional education attempt to create several changes in the inmate: Trade training, high school and/or college achievement, personal and family goals, conflict solving and many others. Regardless of what we try to teach or activities we use, we fail unless the individual inmate shows a real behavior change. When we fail to create a behavior change in our charges, they keep "turning up" like bad pennies. One of our primary goals in correctional education is the reduction of our rather moderate failure rate with inmates.

Failure is the key that locks-in many futures. A large percentage of our inmates are failures at something, or everything. We in corrections must restructure their experiences in such a way as to cause them to succeed, however small the success. One behavior change we must make is being successful. The adage, "nothing succeeds like success", must be the consequence of experiences in correctional education.

I must cry, "Help!" Too long, we in correctional education have been the step-child of all kinds of organizations, boards, agencies and associations. Regardless of the closeness of the ties organizationally, we were still step-children. I feel that correctional education is growing up, in both quantity and quality, ready to take its rightful place in the educational family. Although we are not as numerous as colleges, our graduates undoubtedly exceed those of all colleges. We in corrective education feel that we can and must make our contribution to the cooperative efforts of educators. We must yet depend in large measure on the cooperative effort between correctional education and big brother organizations, such as the American Industrial Arts Association. As younger brothers, we are going to need a great deal of help and cooperation from many organizations in our quest of developing behavior changes.

There is a distinct need for the development of a research exchange organ between the American Industrial Arts Association and Correctional Education Services. We in correctional education have a definite lack of formal dialogue with much of the progressive and inventive research that may even now be established programs and procedures. In many instances, our access to research has been in the trade journals published in the industrial arts field or access acquired by infrequent exchanges with local institutions of learning. Because of lack of coordinated effort and exchange, many research projects are not meaningful except to a few, and implementations into all types of programs unnecessarily delayed. Pride in some phases of correctional education that seem to be more advanced makes us feel that we can contribute our share through cooperation.

The question might arise, how can correctional education services make meaningful contributions to the cooperative effort of research? Most of our problems are like yours, except more advanced, definite, critical and unique. Many public educational institutions by design and control are operated in a manner that restricts or prohibits innovations. In some instances, separation for control groups and other research methods are unfeasible. However difficult it might be in other educational spheres, research would be easily accomplished in most correctional settings. I suggest that we in corrections would welcome research within our "walls". We can offer control grouping of a high degree, varying levels of educational achievement, heterogeneous groupings of background and geographic selections and several levels of resistance to programming. I would point out that experimentation may be accomplished in many cases with ex-pupils in which standard procedures have already failed to produce the desired results. Some may feel that even if a certain program or research goal failed to accomplish its purpose, those experimented upon should not be any the worse for their participation. A full understanding of the possibilities in research in the correctional education program, if analyzed fully, should prove valuable not only in correcting mistakes already made, but in building programs that are workable in the most adverse circumstances.

In most of correctional education, the staff will be found to be basically well-trained, however small or overworked. We of corrections need consultation services in several fields that could be provided by the expertise of the American Industrial Arts Association. We in correctional education can usually find the time and funds for in-service staff training, if we know that it is available and can be applied to our problems. We would welcome any type of interchange that would advance our effectiveness. We could in turn provide opportunities for colleges, universities and others to use our facilities and programs for teacher training (practice teaching in many fields, as just one example).

American Industrial Arts Association consultation services may possibly help to remove the authority barriers that exist in some correctional education settings between varying staff levels and the inmate. When the inmate is aware that the programs and materials are approved by some authority outside corrections, it tends to remove the "psychological threat" atmosphere sometimes formed and encourages the inmate student to trust himself, the correctional education and outside resources. However, we must make clear that unproductive older methods, even some very good ones, may be rejected because of previous failure on the inmates' part. This is the reason most of us in correctional education must use more "systems-approach", results-centered, industry-oriented training techniques, hoping to overcome failure barriers.

Just recently, I heard this thought expressed in a seminar, "Problem adults are just grown-up teen-agers with the same, still-unsolved problems". Most of us, regardless of the field of endeavor, would desire that the American Industrial Arts Association provide more services to effect development of adult- and young adult-level curricula. Some allowances must be made from "hard core" in curriculum development for meaningful classroom confrontations resulting in successful behavior changes. A specific example of one such shift in curriculum emphases would be to produce courses in blueprint reading and understanding instead of blueprint drawing orientation. We need to teach the tools a man needs to help earn a living, not the knowledge he might someday use "if".

Today many institutions of higher learning are faced with the problem of providing educational teacher training services in many new adult fields, such as, adult basic education, continuing education, home life skills and many others, to help cover needs missed by public education. Since we in corrections expect to get at least ten percent of the adult population within our prisons, we would like to see many more colleges add to their curriculum the principles of correctional education administration and teaching. Several colleges or universities have courses on crime, criminals and rehabilitation in their sociology or psychology departments. Very few colleges offer courses toward degrees in correctional education. We in correctional education know that we have very special problems needing educational background study that is relative to corrections. I must concede that courses in correctional education will not be popular or easy to sell to the college student. In my nine years of correctional education, I have met only one person with a degree in correctional education.

I must commend the American Industrial Arts Association for its sponsorship of many useful seminars and workshops in the field of corrections. We in corrections are truly thankful. We would request that they give consideration to greater development of correctional education workshops and seminars of a highly professional nature. We in correctional education stand ready to make any contribution necessary to help the American Industrial Arts Association and others to greater heights of mutual benefits.

I suppose the one thing needed most from the American Industrial Arts Association by correctional education would be services in the areas of standardization and certification. One of our greatest problems is the motivation of an inmate student to achieve a goal when no real recognition of achievement can be given. We beg for joint endeavor in the establishment of curriculum standards that will apply to correctional education as well as public education. We plead for curricula developed toward short, measurable goals and involving meaningful activities. We hope for cooperative processes used in modification of individual learning styles, emphasizing active learning procedures with an eye to the personal nature of individual learning. Textbook writers, publishers and manufacturers of hard- and software, we have a pressing need for standardized handbooks and material on an adult level but simple to use and read. Rehashed junior high school materials are of little value in either juvenile or adult correctional education. Using their expressions, they have "had it". If we produced standard handbooks and materials, involving methods, techniques and approaches for young adults, I feel we would be taking a step in the development of a certification program to grant credit when training standards are met. We need established standards to assure quality training, knowledge of the demands of the trade, and to provide nationwide emphasis on the importance of industrial training.

Throughout correctional education there are new emphases being placed on a cooperative effort among correctional workers, educators, publishers, industrial planners, The American Industrial Arts Association and the informed public. If it seems that correctional education has the most to gain by our cooperative efforts, we in corrections concede the greatest needs. We in correctional education have lived too long as an island. "No man is an island." Neither is any educators' group separate from any other. We all must strive in a persistent effort toward meaningful goals for our charges. We must cooperate and coordinate efforts in our own fields, with others, to strive toward the goal of providing our invaluable service for humanity.

Mr. Yancey is associated with the Federal Correctional Institution, Seagoville, Texas.

The importance of skill development for inmates in rehabilitation

Charles E. Aebersold

To identify people who are disadvantaged academically, socially, culturally and economically is relatively easy compared to the greater task underlying the reason for identification – developing these persons to the level of employability in various occupations.

The individual must be guided to select a job within his scope and abilities. The school must provide a sequence of courses which will enable him to receive the appropriate training. The teacher must employ the techniques and instructional materials which "begin with the student where he is" and take him to the level of skills and know-how that will enable him to work and advance in his chosen occupation.

The abilities of the student collectively and individually, the level of employment to which the student aspires, and the policies of the school must be established. Inherent are the characteristics and the learning style of the deprived. As a rule, many are not equipped or motivated to learn by symbols or abstractions. They have difficulty in listening. They respond much more readily to visual signs, and they like subjects involving physical activity. They reason from parts to wholes rather than from wholes to parts.

They often have a poor time perspective and are slow in performing intellectual tasks. If an area of study is important to them, they pursue it slowly, carefully and patiently until the learning task is accomplished. They dislike being interrupted and having to change to a new situation. They do not easily accept ideas of self-development, self-expression and knowledge for their own sake; they are more interested in learning for vocational purposes.

Programs offered at LaGrange State Reformatory. Recognizing the fact that vocational education was a necessity as well as an opportunity at LaGrange Reformatory, steps were taken several years ago to begin activities leading to some vocational education. Then, in 1967, specific efforts were made to bring the vocational training under the Bureau of Vocational Education of the Department of Education of Kentucky. The Bureau of Vocational Education delegated responsibility for taking over the existing programs and facilities and equipment of the Jefferson Area Vocational and Technical School. Plans were immediately executed to update and improve these programs. Also, plans were developed to increase the number of courses offered to the inmates. At present the following courses are offered: Auto Body Repair, Auto Mechanics, Building Trades, Business Machine Repair, Drafting, Horticulture, Printing, Radio and TV Repair, Residential Electricity, Small Engine Repair and Welding.

Interest in vocational education has been increased or developed in some of the inmates through the various hobby centers located at the penitentiary. There is no pre-vocational training program offered due to the limited facilities and an over-population of inmates.

Placement in classes. If an inmate is highly-trained in one or more skills, he may not enter a regular vocational education class. However, such a person may be utilized by the vocational school as a teacher's aid, consultant, advisor or helper to the instructor and/or students.

If he has had some previous experience or training in a particular area, he goes directly into a scheduled class. He is picked up at the level of his skills, as determined by the teacher.

If he is highly-qualified through an evaluation experience and is highly-interested in a given area, he may be placed directly into a scheduled class of his choice. If the client qualifies in several areas of training and/or instruction and is uncertain as to a definite choice of training, he may be placed in an area of instruction on a trial basis for a short period to assist him in firming up a choice that might be profitable to him. This is done only when necessary and is not a routine procedure.

There is an opportunity for the undecided person to be taken on a tour of all the various classes for which he shows aptitude as determined by the work evaluator. Many times this proves to be very beneficial in eliminating those areas in which little or no interest exists. This narrows the areas of choice drastically. Finally, each one must make his own decision as to what class he really wants to enter. Whenever possible the person is placed in the class of his first choice, if space is available, or he may elect to go into a class which might be his second option. At times a person may prefer to wait until a space is available rather than go into a class of lesser preference. At times we have waiting lists of 25 to 30 persons for certain classes. Some inmates have waited as long as nine months to enter a class of their selection. Every effort is made to place each person in the area of his first choosing.

Linkage among various state agencies. Once an inmate enters the Reformatory, he immediately enters into the sphere of influence of several state agencies, these being Corrections, Rehabilitation, Basic Education and Vocational Education. During his stay, there is an interaction among these state agencies. Upon release these agencies, along with the Office of Economic Security, are utilized to place the inmate into a vocational field for which he is suitable and has been trained. There is a follow-up of his success in his placement. We find that there is a strong commitment from members of the various agencies for his successful entry into a restored life.

Conclusion. Traditional training programs move trainees through the preparatory phase in which actual job performance skills are learned, to an "on-the-job" phase in which performance skills are tried in the actual work environment. Although this system may be the most expedient, it does not take into account the social situation that many trainees must make between job preparation and the actual job situation. Too often we assume that skills in human relations are inherent in persons who desire employment, and we have little patience with those who do not seem to possess "natural" skills in interpersonal conduct. A great many individuals who fail on the job do so, not because they lack the job performance skills, but because they are unable to relate successfully to the people with whom they must associate on the job.

Therefore, we have identified and selected the following objectives as meaningful goals for each inmate at the LaGrange Reformatory:

(1) Develop values and attitudes consistent with his remaining in training and working to capacity.

(2) See himself as an important and positive person.

(3) See himself as a unique individual.

(4) Act in a more socially-responsible way.

(5) Function more adequately without a closely-structured environment.

(6) Involve himself in the training and obtain a positive experience rather than a negative one.

(7) Identify with a more realistic projection of himself in terms of his future.

(8) See himself as gaining from his present experience.

(9) See the staff not as demanding and threatening figures to be resisted and/or out-manipulated; act more independently and creatively.

(10) Become aware of new opportunities and outlets in the employment area and realize that these opportunities will necessitate increased education and training.

(11) Become aware of changes that will occur and directly affect him and his future in the prison, community and society as a whole.

(12) Derive satisfaction from his relations with his peer groups and become less defensive in group relations – displaying more self-control and less sensitivity to opposing viewpoints; be able to express his opinions in the group situation and continue to develop adequate skills in communicating with others and listening to others.

(13) Become aware that people are individually different; become more aware of his own personal tendencies toward stereotyping people.

(14) Become more aware of his strengths and weaknesses.

(15) To restore himself to an acceptable level in society.

Horace Heidt used his now-famous expression, "It is better to build boys than to mend men". Because many of these people were not built as boys, it has become necessary to mend men. We feel that vocational education is the best avenue by which these men can be mended most rapidly and satisfactorily.

Dr. Aebersold is a guidance counselor for the Jefferson County Area Vocational School, Jeffersontown, Kentucky.

Standardized tests: a new tool for evaluating industrial arts education

Hugh L. Oakley

The Cooperative Industrial Arts testing program had its origin in July, 1964, when three representatives from the American Industrial Arts Association, three representatives from the Industrial Arts Division of the American Vocational Association, and two representatives from the US Office of Education met with test specialists of the Educational Testing Service in Princeton, New Jersey, to explore the need for and feasibility of attempting to develop such tests.

In spite of the fact that a lack of a standardized curriculum posed a major barrier to the development of such instruments, the representatives agreed that a continuing program of evaluation was urgently needed, and that standardized measures, based on current curricular offerings, would serve as a starting point from which to evaluate both ongoing and innovative programs.

Following the initial meeting, which was held on July 31, 1964, reports were made to the Executive Boards of the American Industrial Arts Association and the Industrial Arts Division of the American Vocational Association with the recommendation that a steering committee be appointed to work with test specialists of the Educational Testing Service in the development of such tests. Consequently, a joint steering committee, consisting of three members from the AIAA and three members from the AVA, was appointed by the respective Executive Boards. The steering committee met with test specialists at the Educational Testing Service in January, 1966, and made several decisions concerning the broad outlines of the test series. The committee agreed that, in their final form, the tests would focus on achievement in five areas at the junior high school level: General industrial arts, drawing, electricity-electronics, metals and woods.

The next phase involved the selection of test development committees, nominations for which were made by the AIAA and the AVA, and which were charged with the task of preparing test specifications and writing test items. Each test development committee was responsible for a test in a specific area.

The pretests were developed and were administered in the spring of 1968 to schools selected in accordance with recommendations of educators and administrators in the field of industrial arts. Every effort was made to involve only those schools with industrial arts curricula of the type called for by the test specifications.

Ten final forms, two for each of the five tests in the series, were assembled on the basis of item analysis made of the pretesting results. These forms were standardized in the spring of 1969 and constitute the Cooperative Industrial Arts Test series.

In conclusion, it should be emphasized that the Cooperative Industrial Arts Test series came into being as the result of a joint effort on the part of many people who labored long and hard. Thus a new tool with which to evaluate industrial arts education more effectively was born.

Dr. Oakley is on the faculty at Murray State University, Murray, Kentucky.

Educational Testing Service's role in standardized tests for industrial arts

Benjamin Shimberg

When the chairman proposed that I describe how ETS had developed the new Cooperative Industrial Arts Tests, I readily agreed. Then, it occurred to me that ETS hadn't really developed these tests. Indeed, I would be gravely misrepresenting the situation if I appeared before you to claim that we had. True, ETS provided technical and logistical support; but in reality the tests were prepared by you -- members of the profession.

As Dr. Oakley has already indicated, ETS was reluctant to undertake a testing program in the field of industrial arts, until it had assurances from AIAA and the IA Division of AVA that standardized tests were needed and that such tests would make a worthwhile contribution to the field. We agreed to proceed with the project only after both organizations had appointed members to an Advisory Committee. It was this committee that recommended to ETS the fields to which we should direct our attention, the appropriate grade levels, and even how long the tests should be.

I would now like to outline briefly the various steps we went through in developing these tests. I especially want to share with you some of the unanticipated problems we encountered during the pretesting and norming administrations.

(1) Selection of test committees. ETS solicited nominations from AIAA, AVA, USOE and other sources. Each committee consisted of eight individuals: two state or local administrators, two IA educators and four classroom teachers. There were five committees in all: General industrial arts, woods, metals, drawing and electricity/electronics.

(2) Meetings. Each committee met for two days at the ETS' headquarters in Princeton. Under the leadership of a test development specialist, the group developed detailed content specifications, including how much emphasis should be given to recall of factual information and how much to comprehension and application.

(3) Item writing. All committee members accepted item writing assignments--each one agreeing to prepare about 50 items. Thus, there were approximately 400 items initially available for each field.

(4) ETS item review. Test specialists at ETS edited the items as they were received and assembled them into book form. The book was then sent to each committee member, who was requested to select the correct answer and to critically review each item.

(5) Assembly of pretest forms. Following a careful analysis of how committee members keyed each item and their comments, the ETS staff discarded many items and revised others to overcome defects which had been identified. Four 50-item pretest forms of each test were assembled. Thus, the pretest involved a tryout of 1000 items! The pretest was conducted during the spring of 1968.

(6) The pretest sample. Pretest schools were identified with the assistance of AIAA, AVA, USOE, state IA supervisors and members of the various test committees.

Telephone calls were made to IA supervisors and IA department chairmen to ascertain whether or not the ETS tests would be appropriate for use in particular communities. For example, if general industrial arts was offered, was it a two-semester course and did the curriculum cover woods, metals, drawing and electricity/electronics? Also, if separate courses in woods, metals, drawing and electricity/electronics were offered, were they one-semester courses, and was the treatment consistent with the test specifications?

Pretesting was carried out in 54 schools located in 15 different cities in 10 states. At the time the tests were administered, the supervisor was asked detailed information about his IA program, the topics covered, duration and so forth. Approximately one-third of the answer sheets had to be discarded, when it was discovered that the IA program did not satisfy the criteria which had been established for participation.

(7) Assembly of final forms. On the basis of a detailed item analysis, test specialists at ETS developed two 50-item alternate forms of each test. These forms were comparable in content coverage and difficulty.

(8) Norming administration. In May, 1969, the final forms of all tests were administered to IA classes in over 50 schools located in 11 states. Despite efforts to screen schools beforehand to insure the appropriateness of the various tests, attrition was again very heavy. An analysis of information sheets completed by local supervisors indicated that 30-50% of the schools failed to meet ETS criteria for inclusion in the norming sample.

This loss of schools has had serious consequences for the norming sample. For example, only 90 seventh-graders took Form A of the GIA test and only 60 took Form B. Such groups are far too small to be used for norming purposes. It was found that in a number of instances sample size was inadequate for norming purposes.

(9) Reliability studies. The tests were administered to the same students over a two- or three-day interval to obtain alternate form reliabilities. Half of the students took Form A first, followed by Form B, while the other half took B first followed by A.

In addition to alternate form reliabilities, Kuder-Richardson reliabilities were computed to provide a measure of internal consistency.

ETS is now preparing a Test Manual and Technical Report for those who wish to consider using the Cooperative IA Tests. The Test Manual includes background information about the tests, item classification tables, guidance in the interpretation of test scores, and directions on the preparation of local norms.

The Technical Report will cover such topics as validity, reliability, standard error of measurement, item discrimination, speededness and item difficulty.

The Technical Report also provides normative information for each test. Two types of norms are included: grade level norms and combined norms (grades 7, 8, 9).

As noted earlier, the amount of information provided varies with the size of the sample. In cases where the sample was very small, only means and standard deviations are provided. For groups with over 100 cases, norms are provided. However, where the number of cases is under 200, users are advised to use the norms with caution.

Three types of norms are provided in each table: Mid-percentile ranks, percentile bands and stanines. Each of these terms is explained in detail in the Test Manual.

Conclusion. The Cooperative Industrial Arts Tests were developed over a five-year period as the result of close cooperation between test specialists at ETS, the organizations representing the IA profession, the US Office of Education, and over sixty-five dedicated professionals who served on various advisory and test development committees. Also contributing to the project were the hundreds of teachers and supervisors in local school districts who agreed to participate in the pretesting and norming of these instruments.

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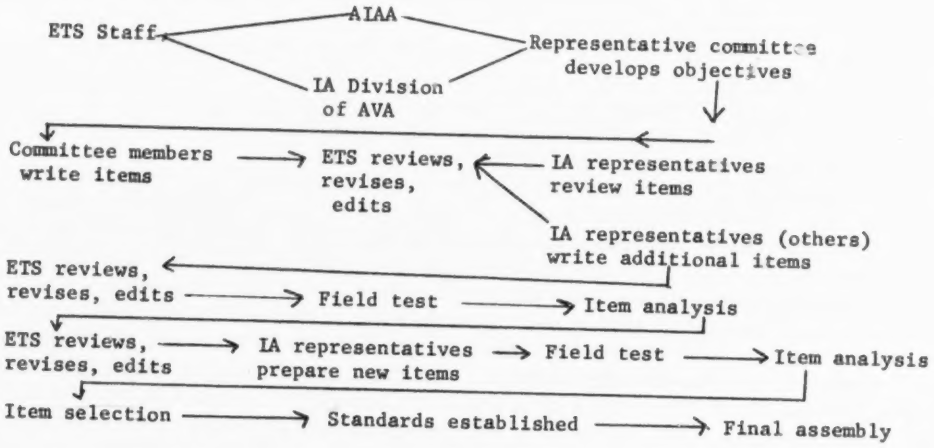
Standardized tests: the profession's point of view

Ralph C. Bohn

Many members of the industrial arts profession, who are involved in the day-to-day job of classroom teaching, recognize the need for innovative ideas. They use the traditional programs because none of the various experimental programs around the country are yet in widespread use. These traditional programs are the ones which would be covered by standardized tests. Diagrammed below is the general procedure followed in evaluating a given project:


ETS Staff
AIAA
IA Division of AVA
Representative committee develops objectives
Committee members write items
ETS reviews, revises, edits
IA representatives review items
IA representatives (others) write additional items
ETS reviews, revises, edits
Field test
Item analysis
ETS reviews, revises, edits
IA representatives prepare new items
Field test
Item analysis
Item selection
Standards established
Final assembly

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Problems in the cooperative industrial arts tests—teacher education's view

Rutherford E. Lockette

The appearance of Cooperative Industrial Arts Tests marks the beginning of an era in evaluation procedures as they relate to the establishment of norms by which to compare students in this field. This gives the obvious potential of facilitating evaluation of programs as they relate to each other. The disparity in industrial arts offerings will certainly come into focus, and perhaps an interesting by-product of the observations made will be an earnest drive to make industrial arts programs on the baccalaureate and graduate levels truly comparable.

The tests purport to assess outcomes in instruction; that is, the level of achievement attained by the student. They will undoubtedly reveal more than this, such as: teacher effectiveness, breadth of course content, the adequacy of instructional aids, the particular focus of some departments, and the extent to which industrial arts objectives are being attained, as well as other strengths and weaknesses of industrial arts programs. The classroom teacher, availed of this additional means of assessing students, can determine from an analysis of scores obtained how his students rank with reference to the larger population of industrial arts students. The tests yield an index by which to estimate the effectiveness of courses of study as they are revealed by analyzing performance on specific test items and/or on specific groups of items.

The teacher educator must realize that data obtained are as discriminative relative to quality, including breadth of undergraduate and graduate degree programs, as they are indicators of adequacy or deficiencies of elementary and secondary school teachers and their students. With reference to this point, item analysis may show what is not being taught. It may point up discrepancies in objectives of a specific course as spelled out by the industrial arts teacher education department and by implied objectives of the normative data group.

The classroom teacher must bear in mind, when reading percentile bands, that these represent the point or band which indicates how the student performs in comparison with other industrial arts students on the test as a whole. The score obtained does not specify individual learning needs. Therefore, scores should not be used as the basis for awarding grades.

The school administrator should view test outcomes as they relate to the improvement of course content, to the provision of additional learning experiences, and perhaps to the updating of laboratory facilities.

The appropriateness of these instruments is dependent upon the industrial arts program in the junior high schools. Naturally, it cannot be expected to provide adequately for some of the newer industrial arts curriculum programs which are in limited use in the schools. However, based on the judgment of industrial arts professionals, the tests accurately reflect the present state of the art.

If an individual is dissatisfied with the content of the test items in the Cooperative Industrial Arts Test – for instance, if it is held that the test does not deal adequately with specific content related to industry and technology, this is not the fault of the test, rather it is the fault of the field. The writer is among those who would place the major responsibility for this weakness on the shoulders of teacher education programs. While it is true that there are forces other than those of teacher education which serve as barriers to the improvement of secondary school programs, teacher education holds as its general function: teaching, research and service. Teacher education has the faculties which are highly-prepared, and they also have or have access to resources which can impact to bring about change. Until such time as change in fact is made, it would be foolhardy to develop achievement tests to evaluate that which we know does not exist.

An opportunity must be taken here to laud those who are developing curricula designed to improve the quality of industrial arts programs. The success of these efforts could result in drastic changes in the Cooperative Industrial Arts Tests in the years ahead.

The advantages of Cooperative Industrial Arts Tests include: 1) the spread of knowledge tested within a specific industrial arts area; 2) the ease of administration which permits mass testing utilizing the various tests; 3) the yardstick they provide for estimating the comparability of programs.

The disadvantages relate to: 1) the differences in programs from one school to another; 2) the possibility that bias exists within the school relative to emphasis on a particular industrial arts area or even segments of a particular industrial arts area.

Without doubt these instruments will become a valuable tool to provide national data with reference to industrial arts offerings at the junior school level. They will also point up the lag between current concepts of industrial arts and existing practices. They will reveal how adequately junior high schools are assimilating new concepts in the field.

Continuing education looms large as a means of closing the gap between knowledge and practices. Continuing education is a major responsibility of teacher education. The Cooperative Industrial Arts Tests should be of real value to the teacher educator in in-service teacher education programs. They should also be of value in assessing pre-service programs. Major changes are needed in both in-service and pre-service industrial arts teacher education programs. Industrial arts teacher educators, take heed.

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Problems involved in using the cooperative industrial arts tests

Ralph V. Steeb

The Cooperative Industrial Arts Tests provide industrial arts personnel with another instructional tool for improving programs. Although the tests are just now being made available, many teachers are unaware of their availability or are hesitantly cautious about using the tests. Because the ultimate value of the tests is derived from their administration and the evaluation of scores, information about the tests must be widely disseminated. Thus meetings such as this will assist in overcoming problems which teachers associate with the use of these instruments.

A frequently-heard comment concerns the content of the tests. Some teachers feel that nationally-prepared tests are not compatible with local situations. Others who are attempting to teach new approaches to industrial arts fear that the learning outcomes of their pupils may not be adequate preparation for the seemingly traditional approach of the test organization. We will always be faced with the widely varying organization of industrial arts programs. Some laboratories are equipped to teach only two areas, which are not sufficient scope to cover all items and areas of the general shop test. On the other hand, the same laboratory would provide insufficient depth for the unit tests. Coupled with the limitations of the number of areas taught is the varying time schedules for industrial arts classes. Not all schools offer a full year of industrial arts, and, in some districts, only nine-, twelve- or eighteen-week courses are offered.

In answer to some of the questions raised in the previous paragraph, teachers may be assured that the tests were carefully constructed to include not only a wide range of content but also items beyond simple tool manipulation. Teachers of new approaches may find that their students can equal or better the scores of students of traditional programs due to the breadth of content sampled by the tests. Of course, comparison with students outside one's own local situation is not advised unless the local situation can be equated with those found in the norming schools.

The cost of purchasing the tests may be a problem to some industrial arts teachers. Since no tests have been available in this area before, industrial arts budgets do not earmark funds for testing. However, all school districts budget for general standardized tests, and the industrial arts teacher should request the purchase of his tests through the central office.

Teachers have been heard to express fear that the tests may be used to evaluate and compare teachers. Such assessment is akin to merit evaluation and would be unfair to the teachers.

Another problem in using the test may be that teachers will not take the necessary time to analyze the test items and scores to draw generalizations individually regarding instruction and to determine weak spots or omissions. Teachers can, through test score analysis, assess the variety and scope of their instructional programs and the attainment performance achieved by the students.

The entire problem of interpreting and adjusting scores may be difficult for teachers. Indeed, it is possible to misuse certain test data. The first outcome of the tests is a raw score for each pupil. A raw score has limited value in interpretation. The score can only pertain to the specific form of the test which was administered and cannot be used to compare scores on other forms of the test. Using raw scores is justified within the same group, providing all members have taken the same form at approximately the same time. Raw scores may be used to indicate the standing of individual students in relation to the group as a whole, but even here caution is called for when the number in the total group is small. Raw scores may be used to assess the performance of different groups of students who have taken the same tests at roughly the same time and same level of their educational program. For the best comparisons, raw scores should be converted into other forms so that student performance can be judged against the nationwide achievement.

There is the possibility that teachers may misinterpret test scores. After reading some of the materials which will be placed in the Test Handbook, all teachers should be able to use the tests and evaluate them meaningfully. One section of the Handbook describes how a teacher may prepare local norms which would be most valuable with each new year and new class section.

The basic unit used in interpreting student performance and one that is frequently misinterpreted is the percentile rank. A percentile rank is simply the percentage of students in the group whose scores fell below a given point. The naive teacher may believe that a percentile indicates the percentage of questions that a student has answered correctly. This is not true, for a student who answers 20 questions out of 40 rarely obtains a percentile rank of 50.

Naive teachers also may fall into the trap of manipulating percentile ranks. This cannot be done, since percentiles should not be added, subtracted or averaged. Percentile units are not equal, because a difference of the same number of points at the center of a distribution represents the larger difference in percentile ranks than does an equal amount at either end of the distribution.

Because a single score is not the best predictor of performance, percentile bands or ranges are useful in determining when one test score is truly different from another. There are factors which affect a student's score on a given test. All teachers know that students may score higher on one day than on another due to fatigue, the facility or practice. If a student took several tests, it would be possible to determine his range or scores for these tests. Using the percentile bands, it is possible to give a more accurate range when using only one test. This is determined by adding and subtracting a statistic known as the standard error of measurement from his obtained score. Chances are two out of three that the student's true score will lie within the range of scores resulting thereby.

To help the teacher in scoring and analyzing scores, the Handbook tells in simple language how to transfer raw scores to percentile ranks, percentile bands and stanines. The Handbook is simply written so that even a new teacher without a knowledge of educational measurements will be able to use it for results. Questions raised by teachers concerning the use of these tests, except where to secure the purchase price, are answered in the instructional Handbook. Reading the Handbook convinces one that the tests are valid and reliable and that great care and statistical analysis have gone into their construction. Teachers should find the tests to be a helpful instructional tool.

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Evaluation

Earl S. Mills

I have been asked to present some practical applications to evaluation as it pertains to the systems approach. Therefore, it is my objective to provide the stimulus that will initiate overt action on your behalf to develop effective evaluation methods and/or techniques in your particular program.

In recent years, in our AIAA conventions, we have been exposed to many different evaluation techniques. Many of the leaders in industrial arts have given us information on content evaluation, product evaluation and cost evaluation, to name a few. In the past several years, we have learned that many of these evaluation methods can be implemented and managed through the use of the computer.

Today, we find that most of our leading evaluators are jumping on the current "band-wagon" to add a very complex variable to the evaluation system, which related to the affective domain. Everywhere we go today we hear people begin to talk about values, where only a few short years ago most teachers said that they have no right to teach values. Now we realize that, like it or not, we all teach values by example: A school cannot be a sterile, amoral place.

A close examination of the various evaluation methods reveals a very basic principle for initiating an evaluation system. This technique, in the words of University of Michigan Philosopher Abraham Kaplan, is the conduct of inquiry or the technique of asking the right questions.

If we were to initiate a new program, there are four basic questions that must be answered:

(1) Where are we now?
(2) Where are we going?
(3) How do I get there?
(4) How do we know when we have arrived?

Each of these questions must be subdivided into many questions and may have to be worded a little differently for a particular program. However, a comprehensive study of these four general questions will provide the basic design for the initial program evaluation.

Included as an integral part of the total evaluation process is the on-going evaluation conducted during the program, and post-evaluation. Many men, such as Bruce Tuckman of Rutgers University, have stated that it is vitally important to design evaluation into a system. I would like to emphasize this point by saying that the system should be so designed that it would be difficult to determine when the instructional activity ends and the evaluation begins.

With respect to an evaluation system, there are three major objectives into which all data can be categorized: 1) effectiveness, 2) efficiency and 3) relevancy.

Let me review these three areas to be considered for concurrent and post-evaluation. A program is effective if it produces the projected outcomes; if it fulfills its objectives. This includes the values in the affective domain. A program is efficient if it can achieve the objectives in the proper time and in the most economical manner. A classical example of the time factor is the apprentice's trade program. Ford Motor Company personnel have raised some pertinent questions, The Cost Factor asks whether the same results could be accomplished for less money.

Some people would say that the third criterion, relevance, is a restatement of the first two. However, a program could be designed that is both effective and efficient in asking some specific activity that no one wants or even needs to learn. Relevance, then, requires the evaluator to ask such questions as:

(1) Are the program's objectives pertinent to the future development of the student?
(2) Has the student been convinced that he should have these sets of skills?
(3) Is there a commitment on the part of the student to learn this particular set of skills, be it in the cognitive, affective or psychomotor domain?

Successful evaluation, therefore, is based on the skills of the evaluator to ask the right questions. May I close with a quote from Dr. Robert D. Gates' presentation in the opening general session of this conference: "Evaluatees must participate in the evaluation or there is no learning."

Mr. Mills is on the faculty of Wayne State University, Detroit, Michigan.

woods

Modern production woodworking machines

Lester E. Schaick

I very much appreciate the invitation to speak to this group, because I feel a frank discussion such as this will be of mutual benefit. If some of my remarks appear to be cynical, please don't be offended, since these remarks are intended to be constructive criticism hopefully to lead to a better understanding of our mutual problems and to find a solution.

It is well to preface this article by pointing out that Freud, in his interpretation of dreams, has no association with the thoughts expressed on the subject. It is not the dreaming that occurs occasionally during the dark hours of the night that I wish to enlarge upon, but the dreams that we must indulge in while conscious, that so often lead to creativity. Dreaming is a necessary part of our existence, since it is an exercise of imagination without which it would be impossible to create anything new or bring something into existence that never existed before.

Imagine its creation, engineer its design and thereby experience the completion of what was once a dream with a degree of satisfaction to the machinery designer. We justly revere the memory of our great composers, poets and artists who achieved immortality through their works, in their dreams engendering the vagrant wisps of inspiration created by their genius to accomplishment have passed down to us to enjoy the fruit of these dreams and let us dream a bit also.

How many of us think of a machine as simply a collection of cast iron, steel, gears and motors? It is greasy, many times noisy and not, I admit, an inspiring sight when operating and even less so when static. It does not compare very favorably with a Browning sonnet or a sonata by Schubert; however, it is a dream of someone and, as such, it deserves recognition, respect and the dignity of an original accomplishment. Look beyond the cast iron, the steel, the gears and motors, and realize that it all started with a clean sheet of paper and the dream and imagination of a designer who visualized the need for something and translated these dreams into reality, with the profit angle many times for human reasons.

How many of you have ever worked at a repetitive task? I have seen many of them in factories visited in the past twenty years – one operation performed hour after hour, day after day, year after year – monotony and boredom, and, to me, it almost seems like a purgatory on earth. I have never subscribed to the idea that many people love these repetitive tasks. To me it is an excuse for illogical thought. It is not the purpose in life for a person to vegetate on an assigned repetitive task that requires no thought whatsoever. It is the duty and obligation of the machine designer to eliminate this boredom and monotony by dreaming of ways to remove the shackles of repetitive work and let the machine effect the release.

As an example of a need in the industry and a designer's dream to accomplish a need, we would like to discuss today one particular machine, namely, the Bell 424A Double End Trimming, Boring, Gluing and Dowel Driving Machine, which has eliminated many of the repetitive, monotonous operations that were, only two years ago, done individually day after day, year after year, by a series of operators. Today there are automatic machines to accomplish better results and to achieve more uniformity, to reduce material handling, to reduce floor space and to eliminate operators and operations by combining a sequence of operations into one machine in one fast cycle.

Let us digress for a moment and review this simple sample which in its simplest form is used in many applications in furniture, kitchen cabinets and related industries. Let us review for a moment the operations you would perform to complete this simple rail to make a simple piece with your existing machinery. Your first operation would be to set the gauge on the variety saw to trim one end. You would then measure for correct length and trim on the opposite end to give you the overall length requirement. From the variety or table saw, you would move to the single end boring machine, make the necessary adjustments and bore the holes in one end. You would then reverse the piece end for end and do the same operation on the opposite end of the work piece. The next step would be to insert glue into the bored holes by using a glue gun, glue bottle or simply a piece of wood inserted into the glue and then applied into the drilled hole. The next operation is to drive the dowels manually with a wood mallet to a given depth. Believe it or not, these operations are being performed day after day, year after year, individually by operators in all parts of the world.

How many of you educators knew a machine such as this existed? It was my good fortune to speak at the Illinois Vocational Teachers' Association meeting in Chicago last month, which opened my eyes to many things. I was surprised to learn that none of the educators in the vocational industry were receiving any of the trade magazines related to wood and wood products. None of them were aware of the machinery shows that are held as frequently as once a year in the United States, which consists not only of American manufactures but foreign machines as well. Fifteen to twenty thousand people annually tour the trade shows to review what is new in the wood industry so that they can tool up to do the very best job with the least number of people.

Let us review the equipment you are using in your schools today. I can recall my father telling me of the type of equipment used in manual training when he went to school, which consisted primarily of a hand saw, hammer, chisel and related items. Today we have progressed to the point where we have table saws, drill presses, single spindle mortisers, hand-operated turning lathes, band saws, jointers, shapers, planers – in fact all of the basic machines in their simplest form. This is not the type of equipment that your students will be working with as they go into the wood industry. So then we ask ourselves, why do we train our future foremen, plant superintendents and managers about wood machining operations on machinery that is practically obsolete in the industry today? We will all agree that the basic tools are a requirement for students in the elementary grades learning basic mechanics, learning to use their hands, getting them to use their imagination and skills; but it is not the way these students are going to learn what is existent or what the requirements are in the wood industry today.

There are many opportunities in wood and related fields. A good plant superintendent today is worth approximately $30,000.00 a year. The industry has a great demand for foremen. Most plant superintendents are self-trained and have knowledge of woodworking machinery, especially in the furniture plants in all areas of the United States. So why shouldn't we be training our advanced students today in the field of modern woodworking machines? It is my understanding that the government is subsidizing 90% of all woodworking machines purchased for school use. There are some areas of the country that are taking very progressive steps along these lines. I cite one example in the North Carolina area where the state is equipping one school with all of the latest, modern, up-to-date woodworking machinery that is available. This school is training foremen and superintendents and managers for the furniture industry. These students will be our future leaders in the wood industry, and they are being trained to meet requirements the industry is demanding today. Related fields, such as adhesives, abrasive materials, sanding, are complete fields, in which methods must be improved to reduce labor, to do a better-quality job, to have greater holding power in adhesives than is presently available today. Technology and machine design, thoughts and ideas to relate these hand methods, which are still being used, must be improved, and I think it is in the schools that we must start getting students to be aware of the situation.

Outside of water and air pollution, housing is one of the most critical problems existing in our country. Government statistics indicate there is a present need for 26 million homes between now and 1978.

The furniture industry is ripe for change. And just as in the case of textiles, an industry that was marked by fragmentation and family ownership two decades ago, the much-needed transfusion of capital, professional management and national marketing is coming from the outside. Attracted by the potential of an under-exploited industry with an annual growth rate of more than 6% and a predicted market of over 7 billion dollars by 1975, a number of major corporations are making substantial investments.

Mohasco Industries, the nation's largest carpet manufacturers, has bought five furniture companies since 1963, and those acquisitions now contribute 1/3 of the corporation's $188 million total sales.

So let us review, once again, the need and requirements of the wood and wood products industry. A revolution in woodworking machinery design is presently taking place. Machines are being controlled by punch cards and tape control. This is necessary when you have multiple stations which require a great deal of set-up time. By merely placing a tape into the machine, many of these multi-purpose, multi-function machines will automatically adjust to their related positions, so it is merely an operator's responsibility to punch the button and feed the material into the machines. Tape-controlled routers were non-existent two years ago. Today they are one of the key machines in any large furniture plant.

There is a great demand, and there will be ever-increasing demand, for good, knowledgeable personnel to keep these machines in operation. There will be further developments along these lines, whereby wood will be cut with laser beams or high-pressure water jets to eliminate excessive waste such as is presently produced from saws in the form of sawdust. More substitutes for wood are being born every day, including particleboard, hardboard, chipboard and even plastics. We say there will never be a substitute for wood and there never will be; however, in certain areas, many laborious hours now spent by individuals in hand carving, hand turning, hand routing and even machine routing will be replaced by plastic injection moulding. We as woodworking machinery manufacturers don't like to see this come about; however, we blame ourselves for not taking greater strides in research development ten or more years ago. But we are reaching the point where we have recognized the fact that we must have trained, skilled personnel in these plants to work with machinery manufacturers to make us aware of the existing problems in industry today. The more knowledgeable people we have in this field, the greater strides we will make towards the achievement of automated machinery and professional men in our industry. We need your help and you can rest assured that we are willing to help you in any way we can.

Mr. Schaick is sales manager, Metalist Industries, Nash-Bell-Challoner Division, Oshkosh, Wisconsin.

Brick, block, mini-garages; front porch in my wood shop

Michael Roger Lund

Changes must come to the nation's public school system. The new assertiveness, the active concern of or by students has our schools on the brink of disintegration. We who teach cannot "stick our heads in the sand" and refuse to accept reality. We know that some of what we teach is old-fashioned, irrelevant and meaningless. No area of education can meet the "Challenge of the '70's" better than we industrial arts teachers. To make a case in point: The consultant in industrial arts for the City of Minneapolis had the foresight to see the developing alienation that is underlying the frustrations that confront both student and teacher. He challenged the industrial arts teachers to "tell it like it is".

I have tried, I believe, successfully to make fundamental changes in our approach to a more meaningful program in our wood shops.

Where to begin? A decision not to capitulate the good in our standards of the past and to include the relevant for the present and future seemed a logical step. We combed the traditional and kept the best. Trial and error, patience and common sense determined the "new", the "relevant".

Today we are more content. The discovery and learning in the day-to-day reality has strengthened our program. We are more resolved to try harder and to meet constructive ends.

The shop today is a "bee-hive" of activity. This writer will not go into detail as to the mechanics and implementation of his program but rather report a brief survey of the activity.

Within a single class hour we find a team of four boys laying block using lime and sand. Note: The lime and sand mortar looks, feels and acts like the real thing.

Another crew of four boys is active in laying up a brick wall using lime and sand. Note: This mixture is easily pulverized and reused time and time again.

A third group of boys is busy hanging gutters, downspouts; laying shingles on a porch roof that is fastened to the wall over the entry way. Using no tacks and self-tapping screws, the materials are used over and over.

Still another group may be pouring a garage slab for a mini-garage (24 x 36 inches). Another crew is following cutting instructions and preparing stock for the garage itself. This writer has developed what he calls "nailing forms" for a simple way of placing the cut material into a jig and nailing it up. Using the truss-type roof has insured success.

Five years and many, many garages later, we find that success is still the best teacher.

No, we did not capitulate and discard the traditional. We still have our coffee tables, night stands and an occasional desk, but it seems the boys enjoy their work more. The boys--and you know boys--don't say it, but you can feel they share the enthusiasm in "Challenging the '70's".

Mr. Lund teaches at Nokomis Junior High School, Minneapolis, Minnesota.

A new woodworking technology

James P. Pastoret

Introduction. The purpose of this talk is to encourage you to upgrade "woodworking", the old bread board concept, to something more interesting, more relevant to the college learning level, more sophisticated, more glamorous, if you like.

New direction. Turn toward the body of knowledge frequently called "Wood Technology" and study this subject, but not too deeply.

Industrial education has not penetrated the intricacies of wood beyond the "naked eye" level. Wood is made of cells, and the cells are put together in a way that accounts for its unique physical and mechanical properties.

Study wood at the macro-level, which implies at a magnified level using a 10-power hand lens.

The study of wood technology at a more advanced level can include work in seasoning and preservation of wood, timber mechanics, design and other subjects.

A number of industrial education schools now have courses in these areas. Kansas State College at Pittsburg now offers a four-year degree in Wood Utilization Technology. Eastern Kentucky University offers a course in wood technology and is currently checking the prospects of offering a two-year degree in wood technology. At the University of Missouri, we are officially coming out with a 9-credit-hour supporting minor in wood technology for graduate students in industrial education. Central Missouri State College at Warrensburg is offering a three-week course in wood technology for industrial education students and faculty this summer. This carries three hours of credit and appears to be an excellent offering.

One word of caution. If you should become interested in a program to upgrade woodworking, be sure to study the problem thoroughly and seek competent assistance. One school of industrial technology requires a sequence of courses including biology, botany, entomology, plant pathology, general ecology and dendrology. They call this an industrial option in wood science. Nothing could be farther from the truth. This is simply a case of "grasping for straws" in the interest of being scientific.

Another school feels they are moving in the right direction by emphasizing micro wood anatomy and identification. This again is a study that does not complement your profession and again a case of frantically seeking a reviving factor. Industrial education majors do not need micro wood anatomy nor should they waste their time in this area of work if, in fact, proficiency in industrial education is their objective.

Things you can do. For those of you who do not have the opportunity to return to school, especially at a college offering work in wood technology, there are other ways to approach the problem. For example, one- or two-day short courses can go a long way toward getting a new program under way. A manual for just such a course is on display on the table. Other books of interest are also there. At a relatively elementary level, the "Woodworking Factbook" may serve you well. We use "Wood as Raw Material" at the University of Missouri in our basic course in wood technology. Then "Wood Technology, Volume I" should be considered a more advanced textbook.

Another source of material that I think is overlooked is assistance from the commercial sector of the economy. There are a number of excellent trade associations that can assist you in your work.

Mr. Pastoret is associated with the School of Forestry, University of Missouri, Columbia.

New woodworking technology

Gerald D. Cheek

I would like to quote something that Frank Lloyd Wright said:

> Wood is universally beautiful to man. It is the most humanly intimate of all materials. Man loves his association with it; likes to feel it under his hand, sympathetic to his touch and to his eye.
>
> Good wood is willing to do what its designer never meant it to do, another of its lovable qualities . . . wood, therefore, has more outrage done upon it than man has done, even upon himself. — Frank Lloyd Wright, "In the Cause of Architecture: Wood", The Architectural Record, May, 1928.

One example of an outrage that has been done on wood is happening in industrial arts today. I would like, if I may, to give you some examples of this outrage. I recently ran across some interesting titles of speeches and articles relating to woodworking -- "Are Woodworkers Becoming Extinct?", "Woodworking A Lost Art?", "Woodworking A Dying Industrial Education Area?". Without reading these speeches or these articles, one might get the impression that industrial arts woodworking is on the way out and that it is no longer a vital area to be studied in industrial arts. It seems that some individuals have formed this impression. This is very sad, if true. It is sad because woodworking has kept industrial arts alive all these years until other areas were born. It is estimated that almost half of the industrial arts teachers teach woodworking.

We once had a fight on our hands with other disciplines in order to survive. We had to convince teachers of mathematics, history, science and English that we belonged in the school systems. That battle has now cooled somewhat, and several new ones are flaring up. Many of these battles are caused by some of our worse critics, and some of these individuals are in our own ranks of industrial arts education. You may have heard that woodworking is overemphasized. The question I would like to ask is: Have the other areas been underemphasized? It is stupid to tear down one area in order to make others look better. Many have built their program's image on this type of foundation, and they must now prove the solidarity of their program.

The new concepts of teaching industrial arts have awakened the imagination of the industrial arts teachers. They have made us question and scrutinize our curriculum. Whether you agree or disagree with their philosophy, you must admit they have given us new impetus to improve our offerings and our programs. Here again the less-informed individuals have taken from these new concepts bits and pieces and blown them out of proportion. Have we in industrial arts lost sight of our purpose and the reason students come to us? Is it your glowing personality or is it the student's desire to learn about industry and to build something? Is it true that in many cases the project has been overemphasized? It should be used as a vehicle to carry information to the student and to reinforce it. The project has even been used as a rating scale to judge the program in which the project was made. But how many industries can you name that make a profit from products they did not manufacture? How many people do you know that learned everything from books and lectures? How many craftsmen are there who have learned their trade by correspondence?

One of our original aims of industrial arts education was to teach about industry. In order to do this many are putting their students in a setting similar to industry. They are studying all facets of industry, including mass production. Where can you teach this better than in the woodworking shop? What other material has the properties to lend itself more to this type of activity?

I have even heard that woodworking does not offer a technology and that woodworking is not in step with modern society. This is very interesting but a little bit strange, because when you look at the records, you will find that what is now the State University of New York at Syracuse, in 1918 started a Ph.D. program in wood technology. In 1920, the University of Michigan started a program in wood technology. In 1923, James Myer graduated from Syracuse with a doctor's degree in wood technology. These programs were quite different, as one program was based on wood anatomy and botany and was started by a man who was a biologist. The other was started by an engineer, and this program was based on wood properties and products. Since then the wood technology programs throughout the country and Europe have united with all phases and aspects of wood. I am bringing this to your attention because some individuals in industrial arts do not consider wood a technology. Wood-centered programs probably started the use of the word "technology". This was long before many knew how to spell "technology", and no one yet has satisfactorily defined it! Many of our critics are not industrial arts teachers but only associated with industrial arts. I know of one instance in a state where a reputable machine salesman has talked school officials into de-emphasizing woodworking in order to emphasize other areas. It is not hard to understand the reason he did this when you compare the price of woodworking machinery to that used in other areas. Why all of these illustrations on what has happened to woodworking? Again, they are to give examples of the outrage done to wood and to those who teach woodworking. It is time for woodworking teachers to take charge of their programs! It is time for you to take charge, not teachers in other areas, not teachers of other disciplines, not machinery salesmen, not the state supervisors, and not the college professors. Learn the new woodworking technology and apply it. Make your program as versatile as it should be. Relate your program to industry and the modern society in which we live.

I believe that woodworking programs in general have resisted change and are now outdated. This is not unique with woodworking, as many of the other areas of industrial arts are still using the manual training methods of teaching. This is not a cure but merely an excuse and should not be accepted.

Industrial arts is divided into areas that represent a certain group of products of industry and/or the material that an industry uses. When you look at course outlines you see that we are teaching a group of skills using certain tools and machines. The course descriptions read like a machinery catalog. Some of them go something like this: The student is introduced to various woods, woodworking joints, hand tools and the basic woodworking machinery. The second course, called Woodworking II, is a continuation of Woodworking I, but a more in-depth study. Woodworking III is a continuation of Woodworking II. The projects made are pieces of furniture made of solid hardwoods. Why don't we have subjects in carpentry, cabinetmaking, interchangeable parts, etc.? Why don't we expand our curriculum and present the industry more thoroughly? Why do we just teach about solid hardwoods when they only represent about ten percent of the wood used in this country? More than seventy percent of our annual sawed lumber consumption, which is over twenty-six billion board feet of lumber, is used in homes, buildings, bridges, all of where load and shock resistant capacity are important. Since this industry is such a large part of woodworking, doesn't it make sense that carpentry and construction should be a part of our program? I recently had a reputable contractor as a guest speaker at one of my graduate classes; he spoke on home construction. After his talk, one of the teachers asked if he had taken industrial arts woodworking; and, if he had, did it help him? The teacher was shocked with the answer. The contractor had taken industrial arts woodworking in high school; but he went on to say that it did not help him, had in fact hurt him, because he was introduced to outdated methods of construction that only related to furniture-making. He also indicated that he was not exposed to the materials that are being used by the construction industry. This man had very definite opinions regarding what should be offered in high school and one of them was a carpentry or construction course. He felt that this would be most beneficial, not only to him, but to the consumer or the future homeowner. We should have courses such as cabinet and fixture construction which are more practical and utilize more materials like plywood, particleboard and hardboard. It is important that our students understand interchanging of parts and tolerances. Many companies producing wood products are holding their tolerances to three decimals. The old adage, "if it is within a quarter of an inch, nail it," is no longer acceptable by modern woodworking concerns. Don't you think by doing this the student would be more able to use this information later on in life? Is it that teachers teach as they have been taught? Are colleges and universities grinding out industrial arts teachers who are not informed about the products and the processes of the woodworking industry?

Just as wood technologists have known for many years, you should know what is wood and its properties. Without knowing these properties you could not possibly have the foundation for your program. Wood with its exceptional characteristics which make it easy to work, its availability and its familiarity puts this material in a position where it is taken for granted. The trial-and-error approach which has been taken when working with wood has become commonplace. This position puts woodworking at a disadvantage when compared to areas using other materials. Knowing the properties of wood could change you from using a trial-and-error approach to a positive, technical and rational way of developing a woodworking program. Without knowing wood structure and its properties, we cannot have this definite approach, we cannot teach in a definite way. To give you an example, by knowing the structure of wood, we can teach identification. We now teach wood identification by using its gross features. Take, for instance, color. There are not enough words in the dictionary to describe a certain color to someone who has never seen it and has not had a chance to compare that color to something else. We also describe woods by the type of grain they have. Is it grain that we are talking about or is it texture and figure? By knowing the structure of wood, and its minute characteristics, we can use the basic key to identify these woods. They do not have to be surfaced, sanded, or be the samples you gave the student to memorize.

By knowing the structure of wood you may obtain a definite approach to woodworking. You may be able to understand why wood shrinks and swells and by different amounts and in different directions. We can begin to understand how glues and adhesives are able to bond wood together. You can find out from studying the structure why wood should be a certain moisture content and why it cups, twists, crooks and bows. Would it not be an advantage to be able to look at a wood and explain to a student what caused it? You cannot determine what are the proper storing and handling requirements for your particular shop or locality without knowing the structure of wood. By knowing this you will be able to understand why one wood is stable and another is not. You can determine for yourself reasons why one wood holds a nail better than another. You will be able to tell why one board of the same species is heavier than another. By knowing the structure of wood you may understand the mechanical properties of wood. Without knowing these properties, how can we expect to understand things like span tables, construction, defects and their effect on the strength, placement of fasteners, and the proper use of joints? We cannot in all honesty understand finishing and machining of wood. Machining of wood is one subject we are satisfied with. Do we really understand the machining of wood or do we just understand how to operate the machinery? If we don't know how the tree is grown, wood structure, and the mechanical properties, how can we understand the grading of hardwoods, softwoods and plywoods? How can we understand seasoning and preservation? This subject is also left out of our curriculum. Almost $50,000,000 annually are lost by damage to buildings by termites and decay. This is more damage than by fire, and we are certainly concerned with this.

Without knowing the properties of wood, we cannot understand the new products that are made of wood. Why are you afraid of plywood, particleboard, hardboard, paper, glued lamination, veneering, moulded wood? Aren't these products used in the woodworking industry? Yes! The United States government reported that the fastest-growing industry today is the utilization of wood residue and those industries connected with it. Why are you afraid of experimentation, such as anhydrous ammonia bending, making wood-plastic combination materials, moulding fibers and mechanical testing? Why aren't you willing to accept some of the new products now being made by industry? Is it possible to really know how to teach woodworking if you do not know what the properties of wood are? Is it possible to teach your traditional pet course in furnituremaking without understanding wood? Most of the time we send our students to look for designs in stores, in magazines, in books, in catalogs that have been discarded. We have students adapt these designs so that we may build them. Now you send a student to the store looking for a design, he makes a sketch and brings it to you. You have him draw it up, plan his work, and then he brings this for you to check. And you say, "Fine, John, go build it." What you have for John to build this project out of is a large variety of solid hardwoods. Do you realize that the manufacturer that produced that furniture did not use solid wood, and that the products he used do not have the properties that solid woods have? Most of the time we do not see the failures that occur after the project leaves our shops. Maybe we gave the boy an "A" on his project and he's afraid to come back and tell you that it fell apart when he got it home. Many designs can only be implemented by using some of the new products, most of which we have tried to keep out of our programs. I know what is being done. I have been there. I have taught woodworking without knowing the new woodworking technology. By doing this, we had failures, and if I had known the technology we could have predicted the failures. When failures occurred I either blamed these failures on the students, lack of skills, on the material, or on some condition I didn't know about. I didn't put the blame on the real cause, my ignorance. It is impossible to really know how to teach woodworking if you do not understand wood. It is impossible to relate your program to other disciplines, such as chemistry, physics, biology, mathematics. We have often talked about making our programs attractive to the more intelligent student, as well as to the average and the below-average student. This is also a difficult job without understanding wood. We have talked about experimentation, research, spontaneous learning, creative thinking, development of the individual human potential, where the action is, new concepts in industrial arts and now man, society, and technology. Can you offer this in your program without knowing what the new woodworking technology is?

I have tried this new wood technology. I believe in it. It has done for our program what it can do for yours. It can give you direction and foresight. It will help you develop and understand what should be offered.

Frank Lloyd Wright also said, "We may use wood with intelligence, only if we understand wood."

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Structure of wood as related to wood identification

Albert G. Spencer

There are three methods of identifying wood--visually, macroscopically and microscopically. The visual method is most often used, because no equipment other than good eyesight is required. Macroscopic identification is accomplished by the use of a 10X hand lens, while the microscopic method requires a microscope. This presentation deals with macroscopic identification only; however, in practice the visual method is often used to supplement the hand lens examination.

All methods of identification are based on the appearance of wood, the characteristics of which are determined by its structure. Thus, an understanding of the basic structure of wood is a very necessary part of the identification process. Since macroscopic identification requires only a 10X magnification, those features of wood visible at that level will be of most concern here.

Before the structural elements of wood can be discussed, it is necessary to point out the planes of reference commonly used for this purpose. The top of a stump or the end of a log provides a view of the transverse, or cross-sectional plane of the wood. A log split in half shows the radial plane, while the face of a slab-sawn board is the tangential surface. All of these terms may appear in the following discussion, although the transverse plane is by far the most important for macroscopic identification.

The basic element of wood structure is a cell. Wood is made up of millions and millions of cells, most of which are tubular in shape, and are cemented together in a honeycomb fashion. For the most part, the length of an individual cell is many times as great as its diameter, so that its appearance resembles that of a fine hair about one-seventh of an inch long.

Most wood cells are not readily distinguishable with a 10X hand lens, but their orientation and arrangement in the wood produce features which are visible, and it is these features that are important in wood identification.

Features common to hardwoods and softwoods. Although the basic components of all woods are the same, hardwoods and softwoods differ considerably in their structure. A cross-section of a log shows the following gross features: bark, the outermost layer, a protective sheath around the trunk; sapwood, a light-colored layer of wood which is the living portion of the wood; heartwood, generally a darker-colored layer of wood; and pith, a small spongy area at the center of the log.

Another feature of wood which is easily noticed is a growth ring, which is the layer of wood added to the diameter of the tree trunk each year. Each growth ring is made up of two layers of wood: a porous layer made up of thin-walled cells is called springwood or earlywood, and a more dense layer composed of thick-walled cells is called summerwood or latewood. Springwood and summerwood are quite important in the identification of softwoods.

The thin lines running from the center of the tree outward are called rays. In softwoods, rays are very thin and can seldom be seen, even with a 10X hand lens. The pattern formed by these rays on the radial plane of hardwoods (as in a quartersawn board), or in the tangential plane (as in a plain-sawn board), is a useful feature for identification.

Features important for the identification of hardwoods.

Pores. Pores in hardwoods are made up of large, tubular cells called *vessel segments*, which are joined end-to-end to form a continuous "pipe", or tube through the wood. When a cross-sectional cut is made on wood, the pores appear as small holes. The size and arrangement of pores are important characteristics for identification of hardwoods.

When large pores are concentrated in the springwood, and smaller ones in the summerwood, the wood is said to be *ring porous*. If, on the other hand, the pores are more or less uniform in size and quite evenly distributed throughout the growth ring, the wood is termed *diffuse porous*. In addition, there are some woods which are between these two extremes, and they are called either *semi-ring* porous or *semi-diffuse* porous woods.

Parenchyma. Parenchyma are wood cells whose primary function is the storage of food and water. Their importance in wood identification is the fact that parenchyma tissue usually is light-colored and is arranged in characteristic spots, patches or lines.

If the parenchyma tissue surrounds or partially surrounds the pores, it is called *paratracheal* parenchyma. Parenchyma tissue which is not associated with the pores, but appears in short broken lines at right angles to rays, is called *metatracheal* or *apotracheal* parenchyma. *Terminal* parenchyma appears as a continuous, whitish line between the growth rings.

Rays. The size, spacing and appearance of rays are distinguishing features of many hardwoods. Oaks have such large rays that they are called oak-type rays, but the rays of many hardwoods are quite small and difficult to see with the hand lens. Also, the fact that some hardwoods have rays more closely spaced than others is a feature which aids in their identification.

The appearance of rays on the radial and tangential surface of wood produces characteristic patterns on certain woods. The broad ray fleck on quartered oak is a good example of this.

Tyloses. A characteristic of some hardwoods is tyloses, a crystal-like substance which partially or completely blocks the pores. Tyloses can usually be seen with a hand lens. White oak is a good example of wood with pores completely blocked by tyloses.

Features important for the identification of softwoods.

Resin canals. Softwoods which are classified as resinous softwoods possess resin canals, which appear as small dots or openings on the transverse surface, and as dark streaks on the other surfaces. The size, number and arrangement of resin canals varies among the different species, so these are useful features for identification.

Transition within growth rings. The layer of springwood in a growth ring is made up of thin-walled cells, and generally appears lighter in color than the summerwood, which is made up of thick-walled cells. If the change from the thin-walled cells of the springwood to the thick-walled cells of the summerwood is sharp and distinct, there is an *abrupt transition* from springwood to summerwood. On the other hand, if the change in cell size is gradual, and the line between springwood and summerwood is indistinct, there is a *gradual transition* from springwood to summerwood. The nature of the transition is an important consideration in the identification of softwoods.

Amount of summerwood. The width of the band of darker-colored summerwood varies considerably in softwoods. Some, such as southern pines, have a wide, outstanding band of summerwood, while others, such as sugar pine, have quite narrow bands of summerwood.

Conclusion. This discussion of the structure of wood was not meant to be comprehensive, but it does indicate those features of wood with which one must be familiar in order to identify wood successfully with a hand lens and key.

Mr. Spencer is on the faculty at Eastern Kentucky University, Richmond, Kentucky.

Procedures for identifying wood by the use of the hand lens and key

Frank M. Pittman

Industrial arts teachers in the area of woods usually spend at least a part of their instruction time on the subject of wood identification. Teachers know that if students are to work intelligently with a material, they must be able to identify it. Consider for a moment the general wood identification techniques. Basically wood identification can be broken down into three levels:

(1) The unaided eye (gross features of wood)
(2) Macroidentification (10x - 20x hand lens)
(3) Microidentification (above 20x - microscope)

All persons who work with wood are familiar with the first identification level, the unaided eye. This method relies entirely upon the gross features of wood, such as color, grain pattern, odor, hardness, weight and sometimes even taste. With experience, woodworkers can learn to identify a number of wood species by this technique alone. It is the easiest of the three levels in terms of complexity but is limited in terms of accuracy and the number of species.

The most accurate and also the most complex identification technique is microidentification, level number three. This technique is used to identify woods by their microstructure. It requires the use of a microscope and a thorough technical background in the minute structural characteristics of wood. This level of identification is sometimes used to verify identifications made by the other two techniques but is probably beyond the scope of most industrial arts programs.

The second identification level utilizes both the gross features of wood, as seen with the naked eye, and structural features not normally visible with the naked eye. It would rank second in terms of complexity and accuracy. Macroidentification is not new. It has been utilized for several years by wood scientists interested in the quick, accurate identification of a wood specimen. Only recently, however, has it been utilized to any extent by industrial arts teachers.

Macro wood identification is a relatively simple technique to learn, provided you have a basic understanding of wood structure and some simple equipment. Briefly, the technique involves viewing a prepared wood sample through a 10x magnifying glass and following the wood's characteristics through a written macro wood identification key.

Wood samples and their preparation. Before you can identify a wood, you must first have a sample to identify. Wood samples may be purchased or individually collected. It is usually desirable to purchase a set of known wood samples to aid in verifying later identifications.

It is best to start learning macro wood identification with known woods which are relatively common to your geographic region. A set of 10 or 15 wood species would be about right to begin with. The size of the wood samples is up to you; however, a piece 3/4 x 2 x 3 inches is convenient to handle and store. It is also desirable that the samples collected contain both heartwood and sapwood, but this is not always possible to achieve.

After the samples have been secured, they must be carefully prepared for identification. Since most of the observations are made on the transverse section, it is absolutely necessary that a portion of the end grain on the wood sample be cleanly cut. It may also be necessary to make small cuts on the radial and tangential surfaces. The simplest tool to use for making these cuts is a sharp pocket knife. A light, quick, shearing cut at a slight angle is best for preparing samples. Only a small section of the end grain need be prepared for viewing. Usually a cut across two or three annual rings is sufficient. The quality of the cut is all-important. Poor cuts will hide the wood's structural characteristics and make identification impossible.

The hand lens and its use. There are a number of manufacturers and suppliers of hand magnifying glasses. Select the best lens that you can afford. The hand lens should be at least 10x, because almost all of the hand lens identification keys are written for this level of magnification. Using the hand lens correctly is important. The lens should be held close to the eye and the sample moved into focus. Good lighting is also essential. Light brings out some of the hard-to-see structural features of wood. Sunlight is best, but a small high-intensity lamp is ideal for inside work. With this type of lamp the light can be directed on the surface being observed.

When viewing a wood sample, make observations both on dry and wet wood. Wetting the surface will sometimes make structural features more easily seen. This can be done by simply moistening your finger tip and touching it to the wood sample.

The identification key and its use. After the sample is prepared, the next logical step is to identify it. An identification key should be used at this point. A key is a written deductive device by which woods can be identified by the process of elimination. The same idea is also utilized by scientists in the identification of plants and rocks.

All identification keys are restrictive in some manner. Their limitations are usually indicated by their title. For example, one key is entitled: Key for The Identification of Important Commercial Woods of the United States. This key is limited to 60 species of wood which are native to the United States and are considered to be of commercial importance. Larger keys such as the one contained in Wood Technology, Vol. I, Panshin and DeZeeus, may serve as a basis for the development of your own key.

In the identification process, examine a statement in the key and either accept it or reject it. The beginning of an identification key is illustrated in Figure 1. First the wood must be classified as either a hardwood or a softwood. Then the specimen is classified into one of the four types of hardwoods and softwoods, resinous or nonresinous softwood, or ring porous or diffuse porous hardwood. After this you are directed to various sections of the key for further identification. If a statement in the key is accepted, proceed to the next statement as directed, until the wood is identified. The identification of a wood should not be accepted as final until additional verification is made. References may be made to known samples of the wood if they are available, or a study of detailed descriptions of the species may be made to verify the identification.

Wood is a fascinating material, and the identification of wood is indeed challenging. Accuracy only comes with experience, but wood identification becomes more interesting and more precise after mastering the microidentification technique.

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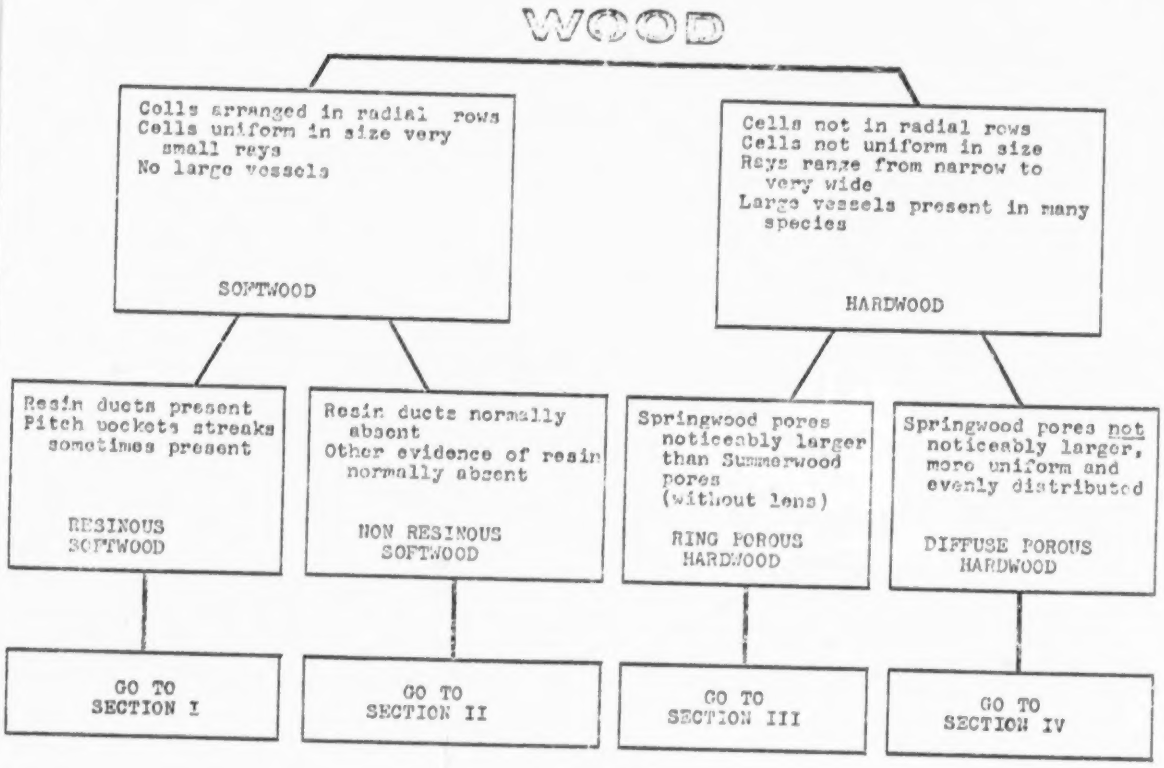

WOOD
Cells arranged in radial rows
Cells uniform in size very small rays
No large vessels
SOFTWOOD
Cells not in radial rows
Cells not uniform in size
Rays range from narrow to very wide
Large vessels present in many species
HARDWOOD
Resin ducts present
Pitch pockets streaks sometimes present
RESINOUS SOFTWOOD
Resin ducts normally absent
Other evidence of resin normally absent
NON RESINOUS SOFTWOOD
Springwood pores noticeably larger than Summerwood pores
(without lens)
RING POROUS HARDWOOD
Springwood pores not noticeably larger, more uniform and evenly distributed
DIFFUSE POROUS HARDWOOD
GO TO SECTION I
GO TO SECTION II
GO TO SECTION III
GO TO SECTION IV

Figure 1

special education

Teaching the gifted—the industrial arts research laboratory

Alan P. Keeny

Let us begin with an assumption--the assumption that in industrial arts we are developing people and not things. I will tell you about developing a particular segment of people--those identified as gifted. One place where this occurs is the Industrial Arts Research Laboratory at Montgomery Hills Junior High School, Silver Spring, Maryland. This group of talented 9th-grade students meets five days a week for the full year.

What is a gifted student? Much research has been done to identify this group, but I believe the work published by Dr. Charles E. Bish in the February, 1961, issue of the NEA Journal best states the characteristics and shall be my basis for criteria. Dr. Bish makes the following statement:

> "There are certain observable characteristics, in a variety of combinations, in talented children. Most of these students learn quickly without drill, organize data efficiently, reason clearly, and show an interest in a wide range of abstract concepts. As a rule, they are above-average in their use of vocabulary and in reading skills."

We now have a concise statement of characteristics to look for when we interview the student for acceptance into the program and are reviewing his personal records and receiving recommendations from his counselor. The students are selected from a total group that make application. Let us also remember that these characteristics are found in a variety of combinations, and many may be hidden. It is my job to select those that show potential--that can be helped by the program. We want to develop the talents.

Dr. Bish also established the strengths of the gifted and found them to be centered in the following abilities:

The ability to see and make association and interrelation of concepts.
The ability to critically evaluate facts and arguments.
The ability to create new ideas and originate new lines of thought.
The ability to reason complex problems through.
The ability to understand other situations, other times and other people, to be less bound by one's own peculiar environmental settings.

Dr. Bish concluded that, "If we are to challenge bright youngsters, we must teach with such strengths in mind." These abilities that are found in the gifted were recognized when the research laboratory was developed in 1959 with the assistance and guidance of Dr. Donald Maley, head of industrial education, University of Maryland.

The first ability - the association and interrelation of concepts. To develop this ability the students must not be forever locked in a single discipline-single period routine, nor confined to a single classroom, but rather must, as in the research laboratory, be allowed or required interdisciplinary functions as are found in seminars, pursuit of research, and freedom of movement. Once freed of the routine--10 o'clock time for math, 11 o'clock time for science--the gifted student can more easily make the associations and interrelations and begin to become involved with as large an educational community as he is capable of using at that time of his development--from the local community to the world community.

The second ability - the critical evaluation of facts and arguments. To obtain strength, exercise is usually needed. The research students receive continuous exercise in the critical evaluation of facts and arguments through the student-run seminars that have the students questioning the procedure, the facts, the conclusions of each other. If there is any one activity that shows the growth of the students over the year it is their performance in the seminar. They become very adept at going to the heart of a problem and asking probing questions. It is also part of their development to look forward to the questioning sessions, knowing that it will help them by pinpointing weak areas in their work which they can then correct.

The third ability - the creation of new ideas and origination of new lines of thought. Can this strength be developed or strengthened in a lock-step program or the cookbook approach or does it require openendedness, a freedom to operate and to choose? The students in the research laboratory choose their problems of study, they develop their test apparatus, they are as current as the latest idea published in the latest issue of any magazine or journal.

The fourth ability - to reason complex problems through. How does the reasoning of complex problems occur? Can it be put into a time schedule? Do we allow two weeks for reasoning or do we offer a freedom of pursuit by the student? In the research laboratory there are no time limits set on the problems under study. It has happened that students have sat for weeks thinking and then with great joy announced they had the answer. It is also true some have sat for weeks and not found the answer--but they had the chance to do so. Is it always necessary to find the answer before we can say we have learned something? The gifted students have expressed their appreciation of being able to investigate to the depth they desired and not give a problem a hit-or-miss approach sometimes necessary when the project is due on Friday, 3 o'clock, ready or not.

The fifth ability - to understand other situations, other times and other people; to be less bound by one's own peculiar environmental settings. To develop and strengthen this ability the program must offer opportunity for the child to work not passively as through books alone but actively as through interviews with leading authorities in their field of study, by telephone conversations, letters and personal contact, so that their environmental settings are expanded and true life work situations can be understood. How much greater is the appreciation of delicate measurements when it is observed at a science center or bureau of standards, when it is related to their problem and they are there. How much more respect will they have for the white laboratory coat of a technician when having the opportunity to work with a technician on laser alignment. These are activities that can and do occur in the research laboratory. They are activities that happen to people who can profit the most from them because of their particular abilities.

By this time you should be beginning to formulate a picture of the program in your mind. You will find it is not a content course but a function program. The student's inherent abilities are being probed, exercised, strengthened and developed. He is not being directed as to what to learn, but given a greater value on the how to learn, which will equip him for his academic future as well as for the predicted drama of rapid technological change in which he must play a part. It is a program based upon contemporary society and upon the needs, interests and motivations of the future citizen. The program makes available industrial arts tools, equipment and materials with which the student can test and evaluate products, processes, materials and ideas applying scientific theories and procedures. In this experience the student selects a problem of interest to himself that can be solved through experimentation. He then outlines the problem and proceeds to determine the necessary approach to obtain valid results and the necessary apparatus to perform his tests. Research into the areas of science involved are a part of expected procedure. The data is checked and conclusions are formed. The final results are put into proper written form and orally presented in a formal seminar. We have now expressed the research laboratory in the simplest form. Visitors have asked, "How do you get them to the level of achievement that we observe?" My answer - I show them how to approach a problem, how to find answers, how to organize and then get out of their way. The responsibility of subject selection and depth of study is placed upon the student. His goal is to become an authority in the field he is studying.

Each student, at the beginning of the course, receives a list of educational values. These values are part of each evaluation that is given the student in the form of individual conferences. He knows his direction and he evaluates his progress toward that goal. The goals are:

(1) To develop an appreciation of the scientific approach to problem solving.
(2) To develop a fuller understanding in the area of industrial research.
(3) To offer a meaningful program through which to teach tools, processes and materials.
(4) To stimulate pupil interest in higher-level laboratory activities.
(5) To provide exploratory experiences of value to the student in his selection of a vocation as well as avocational pursuits.
(6) To develop the student with respect to satisfying his own curiosity, developing self-reliance, and ability to do critical and analytical thinking.
(7) To increase the individual's understanding and abilities in the area of consumer activities.
(8) To develop in the student a feeling of creativity and satisfaction.

I believe that the relationship between our stated educational values found in the program and the ability strengths of the gifted as stated earlier are obvious and do not need further comment.

There is an area we must not overlook and it is important to all students, not just the gifted. It is the area of motivation. Jack R. Frymier, in a recent article, "Motivating Students to Learn", published by NEA, states:

> "What is motivation? In general terms, it is that which gives both direction and intensity to human behavior. Research reveals that students whose desire to learn in school is positive in nature and optimal in level differ in at least four ways from those whose motivation is less desirable: self-concept, values, orientation toward time, and openness to experience."

Much could be said on each point in which the motivated differ from the less-motivated, but consider self-image--the gifted child can become so advanced in a subject that he can no longer find communication with his peers. He begins to feel different, odd, and his self-image suffers. Now place him in a program in which mastery of a field is the norm and with a group that speaks 'his language' and pursues the same goals. What happens to his self-image now? If in his work in this program college professors listen to his questions and give him help, if a representative from industry visits him--what does this do for his image? He becomes a person who is important, can do, is competent. All this and more happens in the research program.

The motivated value the abstract--think of the motivation when the problems are chosen by the individual himself and can be as abstract in theory as the student wants; but even more important, he translates that abstract into the concrete by experimentation, conclusions and explanation.

The motivated show orientation toward time, particularly lack of fear for the future. Is any program more geared to the future than research? The student appreciates the past to establish the basis for his work and finds answers in the present while projecting his work into the future. Thus we meet another motivational guide.

The fourth guide - an openness to experiences. Think of the many varied experiences offered the research student that have been mentioned already, not just in the classroom but in the total community. As part of the program many experiences are required that build upon past experience but lead to new experiences, thus emphasizing the motivation.

THE PROGRAM IN REVIEW -

It is restricted - students must apply - required to have an interview - limited number accepted.

Once accepted, each student receives: white laboratory coat - ID card - clip board - privileges:

- to work throughout the school, not just in one classroom
- to work in library anytime of the day they are free
- to take all-day field trips individually or as a group
- to use school phone to call specialist or obtain materials
- to use school stationery and typewriters (school pays postage)
- to invite specialists or interested people to visit them

The student receives - explanation of goals, guides for scientific method for written and oral reports - evaluations - the expectations are set high. Written and oral reports are required. Seminars are utilized. Visitors from within the school and community are encouraged.

I hope you have noted we have created an atmosphere - a place of work and achievement--a place for success or failure taken in stride and in the perspective of what education is all about. Too often we think of the gifted child as not having problems, but the simple use of the telephone can be an obstacle to him. We think using a telephone is second nature to the teen-ager, but calling a university or government agency or an authority in industry is different from calling your girl friend or buddy. Writing a letter is old stuff--it's required in many of his educational exercises--but a letter that asks for material or information upon which the accomplishment of his project depends puts a different emphasis on the procedure.

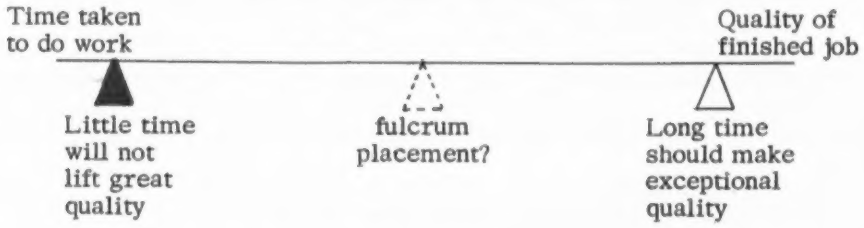
They do like independence. One example: A student teacher was helping one of my students and was taking more time and doing more work for the student than the student thought necessary. The student in effect told him, "All right, you've shown me, now get out of the way, I'd rather do it myself." This is typical of their drive. Many of these gifted students have returned from high school and college just to thank me for the program. They have indicated it was one of the best experiences they had, that it had really helped prepare them because it showed them how to approach a problem, to get information, to be critical. It also showed what really had value--not the grade but the learning. One young lady was so thrilled that she had been able to help her sister in college with procedure to follow, where and how to obtain information.

Year after year the students express amazement at how complicated and how much more work is really involved in their topics. What they thought could be accomplished in six weeks may take eighteen to thirty. It seems our capacity to produce many goods rapidly is leaving some incorrect impressions with our youth. The students also appreciate being able to discuss their evaluations with the instructor. They like being a part of the planning. They like someone having confidence in them. There was an article in the Reader's Digest, February, 1969, Self-Fulfilling Prophecy - A Key to Success. Generally it states that people live up to the faith and expectations you have in them. My students have not let me down. Some decisions have had to be made on the basis of faith in them, faith plus knowing each student's weaknesses and strengths. I have received communications from industries and government agencies indicating the danger and questioning the wisdom of permitting a junior high student to pursue the work. It was then necessary to decide--tell the student it was not in his ability or have him look at the letters, evaluate their message and proceed if he wished. I have never been sorry for permitting them to continue. Occasionally I will talk with them in terms of the following formulas, not reaching any one conclusion but giving them something to think about.

Formula for course accomplishment

$$\text{new learning}\left(\frac{\text{complexity of the problem} \times \text{completeness of the study}}{\text{time to accomplish}}\right)^{\text{power of curiosity}} \text{plus} \quad \text{help given each other} = \begin{matrix}\text{satisfaction}\\ \text{knowledge}\\ \text{grade}\end{matrix}$$

See-Saw of the day of reckoning


Time taken to do work
Quality of finished job
Little time will not lift great quality
fulcrum placement?
Long time should make exceptional quality

Now you have heard what I do with the gifted in my program. Remember the gifted may have the potential but as in most development he needs the exercise to develop. What I try to do is give him the exercise environment and the exercise tools that fit his peculiar needs.

It occurs to me that you who came to the convention and are here now fit the description of the talented: you have shown interest, you seek new experiences, you reason through problems. Since you are gifted, I would like to share an article with you and raise some questions. The article is "Future Shock", by Alvin Toffler. It was published in the January and February, 1970, issues of Playboy magazine. Mr. Toffler's main theme is change and if man can adapt. There is much of interest to industrial arts people in the article, and I strongly recommend you read it. I will quote a few eye-openers:

> "In the decades immediately ahead, we face a torrent of change.... This is the prospect man now faces. For a new society - superindustrial, fast-paced, fragmented, filled with bizarre styles and customs--is erupting in our midst. It has been observed, for example, that if the past 50,000 years of man's existence were divided into lifetimes of approximately 62 years each, there have been about 800 such lifetimes. Of these 800, fully 650 were spent in caves. Only during the past 70 lifetimes has it been possible to communicate effectively from one lifetime to another - as writing made it possible to do. Only during the past six

lifetimes have masses of men ever seen a printed word. Only during the past four has it been possible to measure time with any precision. Only in the past two has anyone anywhere used an electric motor. And the overwhelming majority of all the material goods we use daily have been developed within the present, the 800th lifetime.

"What such numbers imply is nothing less revolutionary than a doubling of the total output of goods and services in the advanced societies about every 15 years - and the doubling times are shrinking. This means that the child reaching his 'teens in any of these societies is literally surrounded by twice as much of everything newly man-made as his parents were at the time he was an infant. It means that by the time today's teenager reaches the age of 30, a second doubling will have occurred. Within a 70-year lifetime, perhaps five such doublings will take place--meaning, since the increases are compounded, that by the time the individual reaches old age, the society around him will be producing 32 times as much as when he was born.

"Behind such prodigious economic facts lies that great, growling engine of change--technology. The time between original concept and practical use has been radically reduced. This is a striking difference between ourselves and our ancestors. In 1836, a machine was invented that mowed, threshed, tied straw into sheaves and poured grain into sacks. This machine was itself based on technology at least 20 years old at the time. Yet it was not until a century later, in the 1930's, that such a combine was actually marketed. The first English patent for a typewriter was issued in 1714, but a century and a half elapsed before typewriters became commercially available. ...it took 65 years for the electric motor to be applied, 33 years for the vacuum tube and 18 years for the X-ray tube; it took only 10 years for the nuclear reactor, five for radar and only three for the transistor and the solar battery. ...What has been learned in the last three decades about the nature of living beings dwarfs in extent of knowledge any comparable period of scientific discovery in the history of mankind. The US Government alone generates over 300,000 reports each year, plus 450,000 articles, books and papers. On a world-wide basis, scientific and technical literature mounts at a rate of some 60,000,000 pages a year.... To most people, the term technology conjures up images of smokey steel mills and clanking machines. Perhaps the classic symbol of technology is still the assembly line created by Henry Ford half a century ago.... This symbol, however, has always been inadequate - indeed, misleading - for technology has always been more than factories and machines. The invention of the horse collar in the Middle Ages led to major changes in agricultural methods and was as much a technological advance as the invention of the Bessemer furnace centuries later. Moreover, technology includes techniques as well as the machines that may or may not be necessary to apply them. It includes ways to make chemical reactions occur, ways to breed fish, plant forests, light theaters, count votes or teach history. The old symbols of technology are even more misleading today, when the most advanced technological processes are carried out far from assembly lines or open hearths. And the assembly line - the organization of armies of men to carry out simple repetitive functions - is an anachronism. It is time for our symbols of technology to change--to catch up with the fantastic changes in technology itself."

The article of Mr. Toffler's is practically a small book crammed with such facts. I cannot take further time--the article can be obtained and read. But if we accept Mr. Toffler's work, where do we stand in industrial education? As recently as this year they called my program innovative--innovative after 11 years? If line production is outdated or incorrect as an example of technology and we teach it in our classroom today to explain industry and technology, what will it be in 10 years? What are we doing to prepare for change? What are we giving our students to hold fast to--a set of changing facts or the ability to accept change, to adapt to it, to reason? Are we giving them a place in the future or fear of it? You--we--are responsible for the answers. Do we accept the problem?

Mr. Keeny teaches at the Montgomery Hills Junior High School, Silver Spring, Maryland.

Industrial arts for the special education student

Herman Cecil Wilson

Your presence here indicates to me that you are concerned about industrial arts for the special education student. We share this concern; in fact, we feel industrial arts is a very important part of the total school curriculum and should be made available to all students.

We realize that special education is a broad term; however, for our purpose we will refer to the educable mentally retarded, frequently called EMR. In general, the IQ range for the EMR students runs from 50 to 75. It is estimated that three percent of the population (4-1/2 million) are considered educable mentally retarded.

Since a child is born with very few natural interests, it is his environment that actually produces enthusiasm to work toward a particular goal. There must also be present a certain degree of ability, and the opportunity to use this ability successfully must be provided in order that the child gain satisfaction which leads to confidence. No one will disagree that constant failure only increases frustration and generates growth of the "I don't care" attitude. Industrial arts can play a significant role in the education of the slow learner.

We cannot be concerned with the learning of facts from a book; we must attempt as a long-range goal to develop students in three major areas: social success, economic success and personal success. With the EMR student we can rely on neither the normal teaching methods nor the simplification of these methods. Rather, we must employ this as our basic philosophy: to start at the child's own individual level, no matter how low that might be, and to serve as the stimulus for his growth in the three previously-mentioned areas--social, economic and personal success.

The program we establish must first meet the needs of these students, in accordance with the available facilities. Considering the combination of the student's motor skill along with his relative intelligence, we must provide a system of rewards and recognition in order that the individuals gain satisfaction leading to confidence. Industrial arts booms into focus at this point, since it is industrial arts that provides the opportunity to combine the use of manual dexterity with mental ability. A skilled mind coupled with unskilled hands means an individual is only partially educated. Units of academic learning modeled along the line of dextrous experiences furnish a more concrete, meaningful learning situation. For example, in teaching the use of tools and materials, it is wise to incorporate the "academics" of number concepts and new vocabulary. Therefore, the student has learned and contributed something worthwhile.

All students, including the slow learners, should be exposed to an industrial arts program, for it is here that they discover getting along with others and sharing responsibilities. In developing respect for tools and materials, they are taught respect for the rights of other people as well as the ability to perform successfully in group work.

To understand why industrial arts is suited for the EMR student, let us look at this student--who he is and what constitutes his personal needs. He is academically below grade level; he can learn but the material must be organized at his ability level. Generally, reasoning power is lacking to the point that he is slow to understand cause and effect relationships, to draw valid conclusions, and to transfer information to another situation. How do we meet this problem? Again, gear the experience to his own stage of development, basing your plans on the quality of the learning experience as opposed to the quantity. Another characteristic of the EMR student is his short attention span, and this may be the most difficult problem to resolve. In addition to providing simple and specific directions for guidelines on a project, the best plan is to furnish interesting projects with a high probability of success. Where there is genuine interest, there will be better attentiveness. Poor short-term memory accompanies short attention span and can best be handled by repetition of the same skill in many different meaningful contexts to ensure more permanent learning, not temporary memorization. In order to overcome the problem of poor work habits, we should assign tasks that require a minimum amount of time. Then, as the student matures and progresses, the amount of time and the degree of difficulty involved can be increased. Socially and emotionally, EMR students are less mature than their peers; therefore, their need is for acceptance by teachers who provide a friendly atmosphere that offers a feeling of security and belonging. Leadership ability is seldom found; thus, we need to guide them as good "followers" in order that they achieve their own personal objectives.

To summarize, let me list for you what might be the most important guidelines in planning successfully for the EMR student in industrial arts:

(I) Use only meaningful activities for teaching techniques.
(II) Use a project that provides the child with his own personal method of expresion rather than a complex end product.
(III) Give the student a voice in the project selection.
(IV) Select activities that improve motor ability.
(V) Compliment the student on his finished product.
(VI) Organize to provide social interaction within a group for exchange of ideas.
(VII) Do not do the job for the child.

The EMR students will always be a part of the classroom, so remember that the accent must be a positive force. Make them feel like constructive helpers--then, perhaps, they'll become less isolated and more responsible school citizens. Praise their strengths; minimize their weaknesses; provide reward and recognition. In short, your every action should say to them, "You are somebody....".

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Instructional aids and devices at the Governor Morehead School for the Blind

Gene Holton Anthony

Foreword. "The teaching of industrial arts and other general shop courses to visually handicapped children has been considered of significant importance for many years, not only for the direct application to industry, but for the development of manual dexterity on the part of the students. In many instances, the teaching of operations, particularly of power machinery, has been difficult for students without vision. Mr. Gene Anthony, a teacher at The Governor Morehead School, experimented for some years with special devices and jigs to make it possible for students to use power machinery successfully. Some of his efforts were recorded in his Master's thesis (excerpts follow). Mr. Anthony generously consented to have the thesis reproduced and distributed to industrial arts teachers throughout the United States with the hope that his contribution would be of value to students in the industrial arts courses and an encouragement to other faculty members to devise more procedures for making the use of power machinery feasible for visually handicapped people."

December, 1966

Egbert N. Peeler
Superintendent

Industrial arts is sometimes referred to as "the doing phase" of general education, in the sense that the learnings are primarily the outgrowth of planned physical activity with tools, machines and materials. In order to develop this "doing phase" to its maximum efficiency, the planned physical activities must be interesting, practicable and safe. Industrial arts for blind students must do several things in addition to achieving its regular objectives. It is necessary (1) "to develop in blind pupils a mastery of those orientation and mobility skills which will contribute to their safe functioning within the shop and (2) to develop in blind pupils particular knowledge of the special tools and aids available to them and to train them properly in their use".(1)

Statement of the problem. It was the purpose of this study to develop and validate various instructional aids and devices for use by blind students. The instructional aids and devices were carefully designed and developed in order to make possible the safe operation of certain woodworking machines by blind students. The effectiveness and validity of the aids and devices were determined and improvements were made. This problem presented enough drawings and photographs of aids so that the reader would have a better understanding of the devices, their construction and their uses. It was presumed that he could apply this information in the construction of similar aids to be used to meet his particular needs.

Delimitations. This study was limited to the students in a woodworking class of the Industrial Arts Department of the North Carolina School for the Blind. The class consisted of six seniors whose vision was from zero to 5%. The study was conducted during a period of one school year. The instructional aids were limited to the following woodworking machines: the circular saw, the band saw and the drill press. The aids and devices were limited to those selected by the writer to best suit the needs of his students. Only those aids and devices made in the industrial arts laboratory were considered for this report.

Need for the study. One of the long-felt needs of the blind students had been ways and means to set up and use safely and accurately various woodworking machines in the industrial arts shop. This achievement may not seem to be a difficult assignment, since it is a commonly-accepted part of the operation of woodworking machines, but it presents special problems for the blind. For instance, how can a student set the fence of the circular saw so that he can be assured of an accurate cut? The obvious answer would be to use a ruler or the gauge as marked on the edge of the saw table. But the Braille ruler--the measuring tool for the blind--does not lend itself to this operation. The sighted student has little trouble reading a ruler. It is relatively easy for him to set the drill press, and other such jobs which make use of the ruler, but the blind student is faced with quite a problem when he tries to do these same operations. The writer had felt the need for some method of measuring that could assure the blind student of success when working on the circular saw, drill press and band saw. The measuring system was the basic need of this problem and was the starting point from which most of the aids were developed.

Measuring aids.

Measuring blocks. The basic aid and the foundation of this problem was the development of the measuring blocks. When it was found that the Braille ruler did not provide the necessary accuracy to be used in precision measuring on the circular saw, something else had to be developed. Further study showed that the most logical way for a blind student to be able to measure and set up the circular saw would be a series of wooden blocks similar to gauge blocks used for precision measurements in metal work. These were made in nine lengths. It was decided that the fewer the number, the easier it would be to explain and use the blocks. Since most of the work done by the students is less than 24" long, the blocks were so designed that the combined length of all of them is 21-7/8". This provided a 1/8", a 1/4" and a 1/2" block, along with blocks 1", 2", 3", 4", 5" and

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(1) American Foundation for the Blind. 1960. Industrial Arts for Blind Students. American Foundation for the Blind No. 6, Group Reports. New York.

6" long. When used in any combination, the student is able to set the rip fence from 1/8" to 21-7/8" from the saw. The original blocks were made 1-1/2" square. Each of the whole-number blocks was marked with Braille. After trying the measuring blocks on the three machines, it was found that the 1-1/2"-square blocks were too big for efficient handling on the drill press and band saw. This led to making another set of blocks, 1" square. Generally, the smaller set of blocks is used on the drill press and band saw, and the larger set is used on the circular saw. The development of the blocks led to the development of several of the aids and devices.

Circular saw aids.

Since the circular saw is not only one of the most hazardous woodworking machines but also one of the most used, the development of aids and devices for safer operation has always been a problem. The aids in this section were developed to meet such specific needs as additional safety and increased usefulness of the circular saw by the blind.

Miter gauge extension. The miter gauge extension is not an entirely new idea; however, two modifications of the usual practice of attaching a piece of wood to the miter gauge made this an important aid for the blind.

When a sighted student is going to cut a board to a marked length using the circular saw, it is necessary for him only to place his board against the miter gauge, line up his mark with the blade and cut it. The blind student finds this very difficult. In order to help the student do this, the miter gauge extension was developed. The end toward the blade was shaped to permit the extension to pass under the guard and was fastened to the miter gauge so the end just cleared the set of the teeth on the blade. This made a good orientation point for the blind student so that he would know where the blade was in relation to his cut-off mark.

Extension clamp. The idea for the extension clamp came about after the miter gauge extension had been in use for some time. Its development came about in this way. One of the main uses for the miter gauge, with or without extension, is to act as a guide when cross cutting. When a blind student desired to cut a board any length less than 18", he would mark his board to the correct length, line up his mark as best he could and cut it. However, it was rather difficult for a student to cut two boards the same length. This practice was found to be rather inaccurate, so the measuring blocks were tried. For example, if a blind student wanted to cut a board 12" long, he would take the 6" measuring block and place it even with the end of the extension away from the blade. Then he would place the squared end of the board against the block and cut the board to the desired 12". However, if he accidentally let the block slip or forgot to check to make sure the block was even, he might cut the board too long or too short. From this problem came the idea for the extension clamp. It was suggested that a block and C-clamp be used, but since this involved several pieces, an all-inclusive block and clamp was developed. This device was called the extension clamp. It is particularly useful when cutting boards up to 6" wide and 18" long.

Saddle. The saddle was developed to simplify the usual practice of using a C-clamp and a block of wood, fastened to the rip fence, to act as a clearance block. The clearance block is a safety measure to provide space between the blade and the rip fence when cutting a multiple number of pieces of stock. In order for the blind students to do this operation safely and accurately, it was found necessary to abandon the use of the clamp and block and make a permanent and removable device. Several devices were designed and tried, but the saddle in its present form offered the best and simplest solution to the problem of providing clearance space.

The saddle is a three-part device. The stop block is used as a clearance block when cross cutting. The top block has a hole bored in one end which fits over the head of a bolt on top of the rip fence and holds the saddle in a clearance position away from the blade. This eliminates the clamp. The 1/8" leg on the saddle may also be used as a measuring block when setting the rip fence to a position. So the saddle has a dual purpose. But it has contributed greatly to more effective and safe use of the circular saw.

Push stick. The push stick is not the usual type commonly seen in most industrial arts laboratories. The straight stick has several features which have proven unsatisfactory for use by the blind student but have been eliminated in this new type.

The purpose of a push stuck is to aid in ripping narrow stock. It is dangerous to use the hands close to the saw blade when pushing the stock through. Probably more accidents happen on the table saw when workers carelessly get too close to the blade. It was the general rule in the Industrial Arts Department at the School for the Blind that no blind student could make a rip cut when the distance between the blade and the fence was less than 2". In fact, this generally held true even when using the old-fashioned hand-held push stick. It is subject to lateral or side-to-side movement which, when a person can't see, may be dangerous. The first designs on a revised pusher or push stick developed a U-shaped block. This fitted over the rip fence and had a notch cut on the bottom of one side to push a piece of wood between the blade and the fence. The original design did the job but lacked flexibility and could not be used with very thick stock. Further study and revision brought out the idea of a pivoted pusher arm to replace the solid block. Several problems in this phase came up, such as the size of the notch. Experiments with varying thicknesses of wood showed that a large notch was needed. Then, to make the two arms of the pusher work together to give proper hold-down qualities, the angle between the two arms had to be determined. When this was done and the proper angle was determined to be 45°, the push stick had been revised considerably but became a very safe and effective aid. The pusher arm is made of 1/4" tempered masonite. This meant that a student could rip stock as narrow as 1/4" and as thick as the maximum height of the blade. Because of the hold-down angle, it was found that there is no minimum thickness--1/28" veneer may be handled as well as 2" or 3" stock.

The modifications of the push stick which finally devised this new type made it possible for the blind students to do many operations which had been previously considered too dangerous for them to attempt.

Drill press aids.

Aids and devices are also very effective in teaching the blind the basic operations on the drill press. Instructional devices are readily adaptable for use on the drill press because the work done on this machine is somewhat repetitive and consists of straight work such as multiple drilling. Several of the devices for the drill press are modifications of ideas generally used in industrial arts shops, while the others are new developments which aid the blind to do more accurate work.

The standard operating procedure for a sighted student who desires to bore holes at certain predetermined places on his wood is to mark his work, center-punch the holes, and drill. In some cases, where he desires to bore several holes the same distance from the edge of his board, he may clamp a piece of wood to the drill press table to act as a guide. For the blind to do these same operations, several modifications had to be made.

The practice of attaching a piece of wood, usually plywood, to the drill press table is not a new idea. This is a procedure which has been in use probably since the first drill press was developed. And it was the usual procedure in the Industrial Arts Department at the School for the Blind. Also the practice of clamping a strip of wood as a stop block to the table was used. In the development program of the aids and devices, it was decided that these same ideas could be incorporated in a more permanent form. First came the idea of a fence to replace the strip of wood usually clamped to the table. Since this seemed possible, it was necessary to decide how to clamp it to the table. Several ideas, mainly along the lines of a rip fence on the circular saw, were suggested. Since this seemed impractical, the idea was changed by suggesting that slots be cut in the table extension and bolts be used to fasten the fence. This was tried and proved to be quite successful. The original table extension was plywood. For the new one with slots, Novaply wood was selected. This provided a smoother, harder surface, and the slots cut therein were easily sanded to permit the bolts in the fence to slide easily.

Directly in line with the center line of the chuck, a 1/2" center hole was bored. This was done to aid the blind student in lining up the table when he was to bore holes. Since it was not always easy to do this, a device was made which helped considerably. This was called a center pin. If a student was successful in lining up the drill press table, he still needed to be able to set his drill press fence and measuring block clamps. If he could not line up the table very well, the center pin would help. So the center pin is used for both operations. When placed in the center hole, it is so designed that one edge of the center pin block is directly in line with the center line of the hole. The center pin enables the blind student to use the measuring blocks and set up the drill press fence. The problem of lining up the bit with the center of the hole in the drill table has been one of the big drawbacks to a blind student attempting to set up and use the drill press completely. With the development of this device, the blind student who wishes to bore any number of equally-spaced holes any distance away from the edge of his work may do so. However, it must be pointed out that center pin requires more time to set up correctly than do most of the other aids. That is, the student must check several directions when setting up. With the proper procedures for setting up being followed, the blind student should be able to do several operations which heretofore were only done by the instructor.

Another significant development in aids for the drill press was the measuring block clamp. In the course of the work on the other aids, boring a hole a certain distance from the center hole presented a problem. A sighted student may rely on his vision to see the center-punched hole, but even though the blind student can use a center-punched hole, marking to the same distance becomes a problem. To avoid having to mark the wood, and very possibly marking wrong, the same reasoning about the extension clamp for the circular saw was used in solving this problem. The block and C-clamp were suggested but, being too cumbersome, were dropped. Again, the built-in clamp with block was called on, and it answered very satisfactorily. The drill press fence was set using the center pin and a measuring block. The measure block clamp was set using the center pin as a measuring block.

The student may need to bore a number of holes along one edge of a board. For example: students need several holes bored 1" from the edge and 3" apart. By selecting the proper measuring blocks, in this case the 3" and the 6", he can bore as many holes as are needed and know each will be properly spaced.

The need for accuracy and speed when setting up and boring holes on the drill press was the primary reason these aids and devices were developed. They have proven to be even more useful than was first envisioned.

Band saw aids.

The band saw is designed primarily for curve or circular cutting. There are, however, some operations which are similar to those done on the circular saw. To utilize its versatility, two devices were developed which aid the blind to do one type of curve cutting and one type of straight cutting.

Circle cutter. The circle cutter is a modification of a Delta suggested circle cutter. However, it varies in several important ways. The slide is locked in position using an oval head screw with a rubber washer. This circle cutter need not be clamped on but has its own built-in guide clamp.

The circle cutter is made of Novaplywood, is 12" x 16", with a 1-3/4" groove cut to permit a 3/8" x 1-3/4" slide with pivot pin to be used for setting varied centers of circles or corners. The pivot pin is located 1" from the blade end of the slide, and its distance may be set by using the proper measuring blocks. The student, when placing his work on the pin, must also know how to find the distance from the left or reference edge. He can do this by using the proper measuring blocks. For example: a 1-1/2" radius cut would place the blade end of the slide 1/2" from the end of the groove, using the 1/2" block. The student would use the 6" and 1/2" blocks to locate where the pivot point would be from the left edge of the circle cutter. By pressing down on his board, the pivot pin makes the hole, the measuring blocks can be removed and the student is ready to cut a circle or round off a corner.

Cut-off gauge. The cutoff gauge is a modification of the miter gauge. It is not adjustable to any angle, since most angle cutting by the blind is done on the miter saw or circular saw. It has an extended arm, numbered, which can be used with one of the measure block clamps. The arm is 14" long and has 7" extending on each side of the blade path. The left or small end of the arm is of such design as to permit the use of a measure block clamp. This makes it possible to cut dowels and other small stock to equal lengths. Such things which use this type of dowel are the tap-ends of the new White Canes and counting boards for elementary children. The problem of how to prevent the blade from cutting through the cut-off gauge arm was solved by placing a wedge block in the milled groove in the table.

The band saw is not as adaptable to aids for the blind as are the circular saw and drill press. Considering the possibilities for the development of aids and devices, the two aids for the band saw represent quite an achievement, according to the blind students. The idea of being able to cut discs or round off corners and to cut round stock such as dowel rods safely gave the blind students a particular feeling of accomplishment. In fact, the two aids were studied more thoroughly by the six senior students than were the other aids, and many ideas for the uses and improvements came from these students.

The effectiveness and validity of the aids and devices were determined by introducing the aids to students who had no prior experience working with the machines or devices. With the proper explanation and orientation it was found that those new to the devices could rapidly understand and properly and safely use the machines because of the devices. In fact, the basis for the effectiveness was that a blind student could explain to another student the proper way to set up and use the devices. Until this could be done, some changes as noted and other slight modifications were made. Only then did the writer and the students feel that some useful aids and devices had been developed.

Summary. It was the purpose of this study to develop and validate various instructional aids and devices for use by blind students. The instructional aids and devices were carefully designed and developed in order to make possible the safe operation of certain woodworking machines by blind students. The effectiveness and validity of the aids and devices were determined and improvements were made. A series of drawings and photographs of aids were presented so that the reader would have a better understanding of such devices, their construction and their uses.

Since the beginning of the experimental program of developing instructional aids and devices began early in the fall of 1961, the six senior students who assisted in the program had many opportunities to study about and use the three machines and the special aids. Several of the aids were modified considerably due to the inability of the blind students to grasp the meanings of and uses for certain ones of the devices. At the end of the school year the students originally involved, as well as all of the other students in various other industrial arts classes, were asked to make comments about and criticisms of the aids. Ideally, it would have been desirable to have given each a questionnaire worksheet Brailled but this was not practical. Oral discussions, analyses and critiques were held, and the findings were generally tabulated.

Discussion of results. The instructional aids and devices were divided into four groups. Group 1 was concerned with measuring devices. Group 2 showed circular saw aids. Group 3 presented information about drill press devices. Group 4 gave suggestions on band saw aids.

(1) The two measuring devices proved to be the most useful. The simplicity of the design of the blocks practically eliminated the chances for errors. The versatility of the blocks was proved by their being used on all three of the machines for which the devices were developed.

(2) The four circular saw devices were found to be very effective in assisting the blind students to use the saw safely and efficiently.

The miter gauge extension and extension clamp make it possible for the blind student to cut stock to length and know that his work will be accurate.

The saddle provides the student with a device to aid in cutting multiple pieces from one piece of stock. The safety factor which involved a clearance block was solved by this permanent, removable device.

The push stick is a new departure in the areas of safety devices to help the blind students rip narrow stock. With the development of this aid, the student does not need to place his fingers in close proximity to the saw blade.

(3) The four drill press devices have proved to be most efficient. Since there is relatively little danger in the drill press, the greatest need for the development of these devices was speed and accuracy of operation.

The drill press table extension and drill press fence are important modifications to the drill press. With the slots in the table and the sliding fence, the blind student is able to make set-ups previously done by the instructor.

The center pin is an effective aid in helping the blind student line up the drill press table, set the drill press fence and set the measure block clamp into position.

The measuring block clamp is a device which acts as a stop block for use on the drill press and the band saw. Used with the measuring blocks, a blind student can set the clamp to a position so that he can bore multiple holes on the drill press or cut multiple pieces of dowel stock on the band saw.

(4) The two band saw devices were primarily developed to give the blind student knowledge of the versatility of this saw.

The circle cutter is a device which has made it possible for the blind to do some types of circular cutting. It does not make it possible to do free-hand or pattern work but does aid the student when rounding corners and cutting disks.

The cut-off gauge is an aid which permits the blind student to cut dowel stock to length. He can cut dowel stock square on both ends or 45° on one end.

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The guidance function of pre-occupational education for the mentally retarded

Roy C. Gill

The title of this presentation alone is an ambitious undertaking, and if we propose to get from here to there in the time allotted, it must be presumed that as educators we have at least a nodding acquaintance with mental retardation, special education, vocational education, vocational rehabilitation, guidance and counseling, Work-Study and Work Experience programs, tests and measurements, individual differences and even some concept of vocational evaluation. I will, however, take a few moments to touch briefly on some of these areas for the benefit of those who would appreciate such a review, and attempt to show how these things are related; even mutually dependent upon one another where the mentally retarded are concerned.

I would like to begin with the following premises:

(1) Work is a basic ingredient in our culture. Most people organize their lives about their occupations. Grave disturbances result for the individual when for any reason he is barred from participation in this most important activity. If he is unsuccessful in finding and holding satisfactory employment, he not only loses his sense of value and worth but becomes a liability to society.

(2) While all education is in a sense "pre-occupational education" and all education performs a "guidance function", industrial arts is unique in that it provides a practical setting in which the individual has the opportunity to explore, assess and evaluate his interests and abilities.

(3) In our society we have adopted the idea that all children have a right to an education--indeed, each child has the right to an opportunity to achieve his maximum potential.

(4) We are well aware, however, that children differ and that all children's needs are not met by a single approach to education. The very uniqueness of the individual implies that some form of individualized programming and guidance is essential.

(5) Lastly, "guidance", to be effective, must be based on valid and realistic appraisals of the individual's capacities and potentials.

Mental retardation can be described simply as an inadequacy in general intellectual functioning which has existed from birth or childhood. The principle tool for establishing the presence of mental retardation has been tests constructed to measure intellectual functioning; however, it has been found that the level of a person's adapted behavior (that is, how well the individual solves problems in his environment and how well he adapts to behavioral expectation and standards of society) can be predicted with only moderate efficiency from knowing his measured intelligence test score. In other words, our current tests of general intelligence are not foolproof measures of adaptive behavior, and it is the deficiency in adaptive behavior, not a subaverage test score, which draws society's attention to this individual and creates a need for social, educational, vocational and legal action on his behalf.

One approach to the classification of mentally retarded is in terms of levels of impairment in adaptive behavior; mild, moderate, severe and profound. The mildly impaired group is comprised of those who, with proper preparation, can be fully capable of independent living in the community and of gaining competitive employment. The moderately impaired are those retarded adults capable of maintaining themselves in a community and performing adequately in unskilled work but who need some continuing supervision and assistance in adjusting to social and economic stresses in their lives. The severely impaired are considered capable of productive work activity but only under sheltered noncompetitive conditions in a protected environment, and the profoundly impaired group is comprised of those persons who are incapable of any significant productive work activity and who require complete care and living supervision.

The schools, being concerned principally with academic skill learning, have found it more useful to classify mentally retarded pupils in terms of programs which have been devised for their special education; educable, trainable and non-trainable. Only the educables and the very upper levels of trainables will be found in the regular school program. Although there have been some special programs designed for the mid- and lower-level trainable in industrial arts classes, we will concern ourselves here only with those we are more likely to find in our classroom.

Special education programs have made tremendous strides in the past 15 or 20 years; however, most high schools are traditionally academic and college prep-oriented. Frequently the special needs of the slow learner and retarded in schools with special education programs are largely disregarded, and only watered-down academic programs are offered for them. In schools where special education and industrial arts departments have cooperated to provide special pre-occupational and pre-vocational curricula, the students have responded enthusiastically by demonstrating good work habits and attitudes. Many such programs involve cooperative arrangements with State vocational rehabilitation agencies, which not only enhances the retardate's chances for vocational success but often leads directly to it. According to the Department of Health, Education and Welfare, the lifetime incomes of vocational rehabilitation trainees average 16 times the cost of training. And nearly 5,000 mentally retarded workers in 40 Federal agencies receive a higher percentage of outstanding performance ratings than any other group of government workers. A national food service company that has employed retarded workers for more than five years found in a comparative performance study that retarded workers stay on their jobs over twice as long, do their jobs well more often, and get along with coworkers far better than the non-retarded workers do.

It is no secret that the typical industrial arts teacher would rather work with the promising bright youngster who has the potential for skilled or professional positions in industry than he would with the slow learner or retarded student. This is quite natural, since the teacher derives a great sense of satisfaction from the knowledge that he is making a potential contribution to technological progress. Unfortunately, there are at least as many below-average students as there are above. And if we really believe in the often-stated premise that it is the educator's responsibility to provide every student with an opportunity to achieve his maximum potential, then we must give the less-well-endowed students the same kind of consideration. Unfortunately, most of our concern appears to be directed toward the education of future engineers, technicians and skilled tradesmen. Little attention is given to the lower third of our population, who will in all probability be the press operators, the truck drivers and the semi-skilled labor force of the future and for whom the climb to vocational competency is just as difficult. Many of the academic skills which the upper half of our population acquires easily and early require a considerable amount of time and effort by the lower third to achieve. In fact, most of the latter will not master the traditional academic curriculum even if they persevere through graduation by virtue of social promotion. Such a situation is certainly not helped if the teachers gear their programs and attention to the upper half of the class. By virtue of his unique link with the real world, the industrial arts teacher is in the ideal position of being able to provide both direct and indirect guidance of inestimable value to his students, and, whether he realizes it or not, particularly to the retarded students. I repeat my original premise that good guidance implies accurate assessment of the individual.

It would serve no useful purpose to describe in great detail specific counseling procedures successfully used with the retarded by professional guidance counselors. Let it suffice to say that counseling with the mentally retarded is much the same as counseling with any other special group, in that these student-clients exhibit a wide range of individual differences as well as a common group handicap. The uniqueness of the MR group is their below-average abstract reasoning ability, which dictates limited and specific counselor goals. Especially important with this group is the need for close rapport between the teacher and the student.

Today, more than ever before, there is a need to identify as early as practical the vocational potentials of the student. In this age of rapid technological development, change and increasing job specialization, it is becoming impossible for youngsters to assess the multiplicity of occupations accurately with respect to their own capacities. School personnel involved in guidance are acutely aware of the limitations of course grades and paper-and-pencil tests as means of evaluating the vocational potentials of their students; nevertheless most students are still counseled on that basis. It goes without saying that assessment of the retarded by such means is not only unfair but completely inappropriate. Further, guidance based on such assessment does not help the retardate to achieve his maximum potentials, since it ignores his true capacities.

What has been found to be effective is vocational evaluation, a technique which originally developed out of the rehabilitation process. Today there are a multitude of approaches to vocational evaluation ranging from simple job trials and work samples to highly clinical assessments by a team of specialists. Vocational evaluation has shown promise of being able to test the untestable person.

Until very recently vocational education was charged with providing an educational service to a select clientele. This was somewhat changed by the Vocational Education Act of 1963, but the impact was minor until the amendments of 1968, which made it very clear that the occupational needs of the handicapped and disadvantaged were to be met. Vocational evaluation emerged as one of the useful technologies for generating an educational-vocational diagnosis for effective guidance.

Vocational evaluation is no stranger to the school setting. It has been used in one form or another for over a decade. In fact, some of the technological development has been carried out in the schools, as exemplified by numerous research and development projects, one of which was designated as a national prototype of school-rehabilitation programs. Even earlier there had been formal interaction between public schools and rehabilitation facilities, and there has unquestionably been a good deal of unpublished vocational evaluation activity conducted under local initiative within various school systems.

Vocational evaluation techniques in school settings are such a common-sense idea that they are an international practice. In Sweden, for example, all eighth-grade pupils spend three weeks working in industry as part of their guidance program, thus utilizing real work as a guidance tool and as a contributor to educational-vocational diagnosis.

In the United States, much of education's involvement with vocational evaluation has been in the fields of special education and vocational education, and in conjunction with vocational rehabilitation agencies which serve disadvantaged youth. Public schools have made use of rehabilitation facilities and other community resources to carry out vocational evaluation, or have conducted this kind of activity under their own direction and responsibility. In many schools the work-experience coordinator is a member of the industrial arts department and sometimes doubles as the evaluator.

The purpose of vocational evaluation is to identify the training and employment potentials of the client; however, it also has important curriculum and guidance implications. It is primarily a diagnostic process, and the data collected points toward recommendations which can be described as prescriptive.

Although the details vary from school to school, the typical cooperative program begins when the teacher refers to the Division of Vocational Rehabilitation students who are likely to profit from rehabilitation services. A special counselor is assigned who schedules basic medical examinations, secures any necessary prosthesis, psychological tests, etc. The formal vocational evaluation program may range from two weeks to three months and is conducted either part-time or full-time at a rehabilitation center, hospital, sheltered workshop or evaluation unit. Less formal vocational evaluations are conducted on campus or on-the-job trials with local work-study employers. Numerous assessment techniques are utilized, including standardized aptitude and achievement tests, work sampling, interest inventories, interviews and observation of general behavior and work performance.

In some instances the General Aptitude Test Battery or the JEVS Work Sample battery are administered in the initial stage. In addition, vision, hearing, arithmetic and interests are cross-checked against referral information. From this initial screening data, an individualized schedule of work samples and job assignments is developed. Frequently, additional standardized dexterity, coordination and discrimination tasks are administered during the course of the client's program as a check on possible progress. Work samples may range from simple short-cycle repetitive tasks, such as assembly, to relatively complex tasks involving a considerable amount of variety and change. The advantage of using work samples, which are either parts of or whole jobs lifted directly from business and industry, is that the tasks are meaningful to the client and provide a means of direct assessment to the evaluator. Some examples of these work samples are: wiring and soldering electronic circuits, weighing, wrapping and pricing articles, setting up and operating a drill press, operating a collating machine and binding booklets, lawnmower sharpening and small engine repair. Each work sample is demonstrated and practiced before actual administration. Observations of speed, quality, attitude and other pertinent factors are recorded by the evaluator. As the evaluation program progresses, the results of each work sample add additional information and point to additional areas of exploration.

Generally, rating scales are used to summarize the objective data collected and to simplify identification of the individual's vocational potentials. In the Phoenix area, a rating scale developed by the Arizona Division of Vocational Rehabilitation is used by several public and private evaluation units which provide services to five separate high school systems. Several other districts have adopted this scale, and modifications are in use in other parts of the country. A unique feature of the scale is that the ratings can be compared with the requirements of nearly 23,000 jobs as described in Volumes I, II, III of the Dictionary of Occupational Titles. In addition, the scale provides significant information for the counselor, special education teacher, workshop supervisor and prospective employer.

The instrument actually consists of seven scales labeled A through G. Scale A is concerned with social and personality characteristics, such as appearance, hygiene, mannerisms, teamwork, etc. Scale B is concerned with work attitudes and work adjustment factors, such as attendance, punctuality, initiative, speed, safety habits, etc. Each item on both scales is defined in terms of observable behaviors, and is rated by the evaluators as follows: 1-always, 2-usually, 3-sometimes, 4-seldom, 5-never. Space is provided for the evaluator's notes or specific observations.

Scale C relates to aptitudes and covers intelligence (G factor), verbal (V factor), math (N factor), perceptual (C, P, S and Q factors), coordination (K factor), and dexterity (M and F factors). Each of the 22 items in scale C is also defined. Rating is as follows: 1-extremely high degree of ability (possessed by the top 10 percent of the population); 2a-high degree; 2b-above average degree; 3a-slightly above average degree; 3b-medium degree; 3c-slightly below average; 4a-below average degree; 4b-low degree; 5-negligible amount of ability (possessed by the lowest 10 percent of the population). The ratings of 3a, 3b and 3c are possessed by the middle third of the population.

Scale D is concerned with temperaments in terms of the types of work situations which the individual is capable of adjusting to and performing in. These include short-cycle repetitive, variety and change, working alone, stress, etc. Descriptions of typical situations are included in each of the ten items.

Scale E identifies the individual's interests or preferences for engaging in various activities. The 10 items include things and objects, contact with people, routine, creative activities, etc. Scale F covers the physical capacities of the individual and includes such features as strength, agility, equilibrium, senses, etc. Scale G describes the environmental working conditions that the individual can tolerate without noticeable discomfort. These include indoors, outdoors, heat, cold, humidity, noise, vibrations, dust, etc.

Scales D, E, F and G are rated on a simple yes or no basis and provide for the evaluator's comments and observations.

Direct comparison of specific jobs can be made from scales C, D, E, F and G, and potential occupations based on the student's interests, aptitudes and capacities are identified by the evaluator.

Although the means to individualize guidance further and to make maximum use of the students' last years in school is available, it is not being utilized in many areas. Possible explanations would include lack of awareness on the part of teachers, counselors and even evaluators of the potentials inherent in pre-vocational evaluation data. Another possible reason the practice is not more widespread could be that educators have traditionally resisted outside influence. Some, no doubt unconsciously, resist assistance in the vague fear that it will be an admission of inadequacy.

Obviously no school or teacher can provide for the total needs of the retarded student. The unique learning problem and educational objectives of special education students call for a multidisciplinary approach, and no school or teacher should hesitate to mobilize all the resources available to assist the retarded in achieving maximum social, personal and economic independence.

In schools where there are special education programs, the industrial arts teacher can make a significant contribution to the pre-occupational education and guidance of the retarded by becoming a member of the multidisciplinary team. In schools where no special education services are available, the industrial arts teacher may well provide the only meaningful exposure to pre-occupational education and vocational guidance that the academically handicapped youngster has.

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The guidance function of pre-occupational education for the gifted

Leon T. Harney

Occupational education is a relatively new combination of words, and so we do not have any semantic differences. From the outset a discussion of the term is deemed advisable. With all the innovations currently being studied and tested in industrial arts and vocational education, it appears that many feel a need to combat the societal stigma associated with vocational education and have changed the designation of this field of endeavor to occupational education. The study of occupational information has long been a stated objective of industrial arts. It will continue to gain in importance as educators think more about serving the sixty or seventy percent of the high school population who do not desire or have the ability to succeed in the strictly academic college-oriented curriculum. The role of industrial arts, then, is pre-occupational education at the elementary and junior high school levels and in some instances also at the senior high school. The senior high school industrial arts program can be a very effective pre-occupational education course where the junior college systems as found in a number of states are strongly developed for occupational education.

Industrial arts has not been noted traditionally for a large number of the so-called "gifted" students participating in our programs. The problem of semantics arises when the term "gifted" is used. Just what do we mean when we talk about the gifted? The IQ score has long been an indicator of one type of gifted student, but industrial arts teachers have all seen students with high IQ scores who were not gifted with motor skills. The industrial arts teacher, on the other hand, has worked with and helped to develop the figural ability of many to the point of the students' excelling to a gifted level. The work of a number of researchers during the last decade with creativity and creative problem-solving has revealed that industrial arts can foster creative problem-solving abilities in the area of fluency or the thinking up of new ways of doing and using common articles. Also the figural abilities where utilization of concrete ideas is developed in wood, metal, plastics and many other industrial materials can be enhanced.

The industrial arts teacher is in a unique position to counsel students in pre-occupational education courses, since he is well-acquainted with the field of work. The gifted student has problems with occupational choice just like the majority of the student population. It is important that an ideal relationship be established between the counselor and the student. The following are most characteristic of this ideal relationship:

(1) The counselor is able to participate completely with the student's communication.

(2) The counselor's comments are always right in line with what the student is trying to convey.

(3) The counselor is well able to understand the student's feelings.

(4) The counselor really tries to understand the student's feelings.

(5) The counselor always follows the student's line of thought.

(6) The counselor's tone of voice conveys the complete ability to share the student's feelings.

(7) The counselor sees the student as a co-worker on a common problem.

(8) The counselor treats the student as an equal.

In order to establish a creative relationship, many counselors will have to change strategies and establish a real rapport, joy and pride in the creative powers of the gifted student.

The identification of the gifted is still a problem for all education. The tests that have been traditional screening devices are not adequate. A number of tests and research instruments have been tried, and it appears that a combination of the traditional IQ measure and the creativity measure will soon be available. A test made of categories that measure reasoning ability, verbal ability, spatial ability, number ability, memory and ideational fluency is being developed. To determine where the gifted student might profit most from pre-occupational education and to receive proper guidance in the correct educational tract, a figural ability measure also seems desirable for use in innovative programs.

The curriculum designed to utilize problem-solving, research and experimentation with wide individual latitudes seems to help this group of students to profit most from their educational endeavors.

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Teaching about the human side of enterprise

E. Robert Welsch

In a time of rapidly-growing technology, where too many of our young people remain unemployed after leaving secondary school, and relatively few acquire skills through occupational training, it appears clear that your endeavor is especially critical to America and our private enterprise system. This system is still the wonder of the world. It can do more, better, than any yet conceived. The industrial arts concept and the continuance of progressive improvement in the technical training curriculum will be a keystone for the further success of the private enterprise system during the last third of this century.

Teaching the human side of enterprise should, in my view, assist the student to gain an appreciation and a practical grasp of the human relations of his job in the work world. I define human relations as the way he behaves with people. Due to your good efforts, the odds are overwhelmingly in favor of your student's technical training proving more than adequate for his work world job. The odds are equally high that the frequently difficult, and probably most complex, aspect of his effort to reach job success, present and future, will be personal skill in getting along with other people. Doing a good job of teaching about the human side may well be your greatest challenge. Our youth of today seem to realize this much better than my generation. Some of their slogans, such as "flower power", "love" and "peace", show that they see the need for human understanding. We should accept these expressions in a literal sense. We should not dismiss them as part of a meaningless drive for self-gratification.

It should be helpful to review some of the significant human aspects of the enterprise structure. First of all there is management. The managers are responsible for assuring that enterprise objectives are effectively reached through the work of the employees. These days, the managers are frequently a professional group accountable to the owners. Corporate owners are the shareholders. In the case of government enterprise, the owners are all the citizens of the community.

Since the technical student will in all likelihood graduate into a private enterprise job, we might well take another quick look at this type of enterprise. Is it a cold, hard, profit-making entity, as some contend? Or does it have a human side?

Actually, the profit goal is just one of three primary objectives. Long-run stability and profitability can only be assured if a service is economically provided and if the provision of this service makes a contribution to the social well-being of the community. In recent times many of our youth have vocalized their desire to participate in the making of a meaningful contribution to society. This justifies an extra word about the service and social objectives of private enterprise.

The service must be needed and desired. A business obtains a customer by supplying a quality product at a competitive price. In order for the enterpriser to capture his share of the customers, he must project the proper image in the community at large. His image must be that of a responsible, concerned citizen. Also, if the enterpriser is to be competitive, he must attract and retain capable, loyal employees. This competition may be as vigorous as the competition for customers. If the enterpriser skimps in competing for qualifiable employees, his business will not long exist. Therefore, his policies on work environment, salaries, illness, retirement and other fringe benefits must be enlightened and progressive. We are no longer living in the days of enforced child labor and the jailing of a Eugene Debs. Private enterprise is aware of this, and you, as teachers of our young people, have aided immeasurably through fairness, warmth and the personal contact of the classroom. Today business management may include employee participation in community social-civic affairs as part of the job performance requirement. I believe the banking industry is noteworthy in this regard.

The threefold objectives of private enterprise are: Service, social contribution and profit. They are achieved through quality performance by the individual and the organization. Immediate reward, monetary and psychic, is in relative proportion to how well the present job assignment is carried out.

Longer range rewards include another dimension. This is the career ladder. In the work world we ordinarily refer to this as the ladder of promotion. The distance your student eventually progresses along this ladder will depend on how well he continues to prepare himself for the upward steps. Career ladders move from entry-level jobs to expert operator, then supervision and management. For example, in a commercial bank an employee proceeding along the ladder may move from messenger to silver teller. He could then advance to commercial teller and senior commercial teller. A next step could be assistant general teller, then paying and receiving teller and senior paying and receiving teller. From here the employee could move into supervision as an assistant branch manager and then branch manager. Another interesting example of a fast-growing career field is electronic data processing. After entry as a key-punch operator, the individual may advance to senior key-puncher, machine operator, senior machine operator, computer operator, programmer, senior programmer, systems analyst, senior analyst, assistant manager, data center and manager, data center. You and I know that some students will skip this general ladder of advancement through special ability or luck, and the like. (They might even marry the boss's daughter!) But for most people the advancement ladder is a hard fact of life. Fortunately the "hard fact" of human relations can be softened through teaching. Students may be motivated through your indication that many firms, including mine, strongly encourage and financially support continued employee educational course work to augment career development. For the employee with supervisory ambition the need for mastery of the human relations skill will become more demanding as an integral part of the broader function of motivating others. From the instructional standpoint, I recall that in my schoolteaching days I hesitated to require my students to tackle assignments I considered too advanced. Today you, as educators, are aware that your students can absorb more than we once thought they could. You must present to them ever more difficult achievement goals.

I would like to address the teaching of human relations in the work world job in two perspectives. The first perspective involves enterprise human relations or citizenship. "Enterprise citizenship" includes personal feeling and attitude toward the management--the group charged with the function of executive leadership, the function of achieving the objectives of the enterprise. I submit that your favorable attitude toward enterprise in general, and the private enterprise system in particular, will go far in preparing your student to become effective in working with his supervisors and managers. Technical competence will fail to gain work world success if combined with poor enterprise or corporate citizenship. Specific study can profitably include basic things the enterprise management wants from employees: punctuality, regular attendance, personal neatness, cooperation and receptiveness to instruction on the job, recognition and respect for the various responsibilities of fellow workers, loyalty, job dedication and hard work, resourcefulness and initiative.

The second perspective is "individual human relations". This is not exclusive of enterprise citizenship. Skill in personal human relations will assist your graduate toward successful company citizenship if he combines it with a good attitude toward his management. The Peace Corps is most worthwhile, but students should be encouraged to realize that it is not the antithesis of big business. So much good can be accomplished in one's own community by working for a firm which contributes to that community through its services and related contributions, financially, socially and civically.

From the teaching standpoint, individual human relations may be most simply stated as giving students a strong appreciation of the necessity for developing and maintaining positive working relationships with fellow workers. The curriculum should emphasize the importance of course work designed to provide working relationship skills. It is important constantly to interrelate technical and human relations skill development in the occupational education process.

Study in business English, report writing, speech, literature, social ethics, history and biography is certainly pertinent to student human relations training. Biographical study of such enterprise greats as Ford, Vanderbilt, Watson, Knudsen, and others, provides a grasp of the human dynamics in business growth. This kind of subject matter could begin at the junior high school level on a spiral curriculum basis and continue into progressively more difficult levels of study.

It seems to me that teaching the human side would also include a basic study of the psychology of personality, human relations and motivation per se. Again, on a spiral curriculum basis, the technical student can be given a grasp of human make-up so that he can better understand himself and others.

Students should learn the importance of individual differences. You probably read where Bob Hope, years ago, as a vaudeville entertainer, did a dance routine with Siamese twins. Recently he was approached by these same twins in a night club, and one said, "You probably don't remember us -- but --." An individual difference? I think so.

Maltz, in his Psycho-Cybernetics, presents a concept of people as goal-striving creatures. Furthermore, the unconscious computer in each person is programmed by the pictures created in the mind. The computer is impersonal and produces as it is programmed. Our computer cannot distinguish between real and imagined experiences. If failure is imagined, the imagined experience becomes real, and, likely as not, failure will be experienced. If a person can imagine success, the odds are he will experience success. The student who thinks he is not worth much and who lacks self-confidence can change his programmed behavior so that he truly believes in himself. With a success-oriented image of himself, the student will have developed a sound psychological base for setting occupational objectives through his counsellor, for gaining the most meaningful benefit from his school training and for attaining the desire to excel in the work world.

The student can profitably be given a knowledge of the things he and others want, the needs we all constantly strive to satisfy. The behavioral scientist A. H. Maslow, in discussing "A Dynamic Theory of Human Motivation", outlines the type of concept which is pertinent to this study area. He talks about levels of aspiration: beginning with physiological needs, he describes successively higher needs--safety, love, self-esteem and self-actualization. In this context man strives to higher needs after the lower needs are satisfied. A person's position in this spectrum conditions the way he acts. A grasp of such concepts as Thorndike's "Law of Effect" and the significance of rewards and punishments on behavior is certainly pertinent to a knowledge of motivation and the development of individual human relations skill.

Much could be said, but let me summarize this aspect of my remarks by saying that this part of the training curriculum should serve to clarify the dynamism of formulating values, as shown in attitudes, resulting in positive behavior patterns on the job. Study of this arena will encourage development of a down-to-earth personal image, accepting shortcomings along with strengths and reconciling any conflict between what the student is and what he thinks he should be. He can then be led toward the use of empathy: projecting himself into the shoes of his fellow students and future fellow workers. Through study of human make-up and use of empathy, our student will have the necessary know-how to get his fellows to like themselves better. He can assist them to build a higher, better, happier image of themselves. He can develop and maintain positive working relations with others.

Student grasp of enterprise and individual human relations dynamics can be aided by utilization of business organization model project work requiring several joint participants. These projects should be designed to bring out the need for empathy, compromise and conflict resolution in order to reach specified objectives. Further actualization of work world situations should be obtained through enterprise field trips and visitations. Such visitations should be a meaningful part of introductory study of the world of work at the junior high school level. Junior Achievement throughout our nation has done a marvelous job of aiding students in the understanding of profits, losses, production and related phases of the work world.

I strongly encourage actual student involvement in the work world at the high school level. Cooperative Programs are a highly desirable supplement to in-school technical study. The Cooperative Program adds the dynamic ingredient to training. It helps you to recheck student technical ability and interests with current occupational objectives. It assists maintenance of teacher contact with work world activity. By its nature it necessitates continuous counselling and guidance. It encourages the correct timing of school study with requirements of the projected job. It develops the student's sense of personal worth, pride and financial responsibility. It augments skill development in human relations.

At Citizens Fidelity Bank we employ co-op students from Louisville high schools in branch operations, check processing and accounting. The program is highly regarded by our organization. Several co-op student graduates have joined our permanent staff.

In summary, teaching the human side of enterprise through appropriate emphasis in the technical curriculum is essential to the success of your overall educational program. Technical competence is essential but not enough. Effective human relations is the constant variable, the vital "X" factor which is necessary for success in practically all vocations. In this generation, every young person should have the opportunity to reach his potential. The recent legislation broadening the scope of technical education should enhance this opportunity. A progressive increase in your student ranks is important to the future of our youth and the nation's enterprise. We in the business community will continue to lend our support.

Mr. Welsch is vice-president and personnel director, Citizens Fidelity Bank & Trust Co., Louisville, Ky.

Go where the action really is

George W. Howell

Today I feel much indebted to Richard Vasek--first, for providing me with this opportunity to participate in hearing these fine presentations and, second, for allowing me to share with you some views which I hope will be helpful to industrial arts educators in achieving the point of this morning session--Content Enrichment for Industrial Arts.

But third and foremost, I am indebted to Dr. Vasek for introducing me to industrial arts. I must confess that when I was approached to appear on this panel my concept of industrial arts was that it involved only the narrow view of vocational education, that is, the acquisition of trade skills. This I know something about, for in the last several years my company, the Ingalls Shipbuilding Division of Litton Industries, has trained almost 3,000 young people in shipbuilding skills. However, Dr. Vasek soon disabused me of this notion of industrial arts. I then began to research some materials which he sent me and became very excited, for I found that there is a great kinship between the modern approaches to designing and teaching the industrial arts curriculum and the business philosophy of Litton Industries--principles in which I personally firmly believe.

Now I am referring to industrial arts in the broadest sense--as a study of industry and how it affects people in all walks of life. This, by definition, includes a study of technology, for as industry is the chief agent for the application of pure science to improving society, the vehicle is technology.

And I find that one of the topics at your 1966 convention was "Industrial Arts--The Curriculum for Orienting Students Into America's Technological Society". The theme of this convention is "Man-Society-Technology". And through other industrial arts materials I have recently read I find some steadily recurring and familiar themes, as follows:

(1) Knowledge is exploding at an exponential rate.

(2) Nothing in our society is as constant as change.

(3) Industrial technology is the means by which we make practical applications of new knowledge for the improvement of society.

(4) Technology is therefore likewise exploding.

(5) Man must master change in his environment and in technology or be overwhelmed by it.

(6) Therefore, man should concentrate on being adaptable to change.

For much more learned treatments of these themes I refer you to the following excellent presentations:

Dr. Paul W. DeVore at your 1966 convention
Mr. Earl C. Funderburk at your 1966 convention
Bulletin No. 8 of your Association, by Dr. Donald Maley
Bulletin No. 9 of your Association, by Dr. Earl M. Weber.

The themes are all basic elements of the philosophy of Litton Industries. By applying these principles to the business world, our company has grown from its inception a little over fifteen years ago to a $3 billion sales per year corporation. But there is one additional tenet which we add to the Litton philosophy, and which I commend to you: This is to anticipate change or create change where it is needed rather than to wait and react to change. In this way one can become the master of change, leading it into constructive channels and more nearly controlling one's destiny.

Now, to the topic of this session--Content Enrichment from Industries' Viewpoint. The subject of my presentation is "Go Where the Action Really Is"; the purpose of my remarks will be to advance the following points:

(1) There is a great lack of understanding among today's youth as to the merits of our free enterprise system.

(2) The solutions to the most pressing problems in today's society can only be provided through an enlightened business community applying our vast technology within our free enterprise system.

(3) Industrial arts educators must join with business in creating out of today's youth the motivated and adaptable business leadership of tomorrow.

In a recent article entitled "And One Thing Certain", Columnist Henry J. Taylor posed this challenge to American business. Mr. Taylor said:

> "American business is shattering a duty like a dropped egg. The duty is the articulation of American free enterprise fundamentals. And one thing is certain:

> If those who believe in free enterprise are not willing to defend it, those who don't believe in it will take over.
>
> "An American Association of Advertising Agencies survey indicates that about nine out of 10 - 88 percent - of the surveyed college students say they'd prefer careers in government, a profession or academic life rather than business. Behind the blindfolds of their ignorance, they see business 'removed from social and moral affairs', 'dull', 'non-creative', etc.
>
> "There are 68,000 full-time law students in the country. Polls show that the majority disdain corporate law. They talk about the future opportunities in it as if a business life were somehow shameful and not a life worth living.
>
> "For example, the 39 editors of the Harvard Law Review are considered the university's top and most-promising students. At a recent symposium they stated that it is unlikely that a single one of them will enter business practice. Their expressed interest - all 39 - is in the legal aspects of poverty affairs, pollution, consumer protection and social reforms - practically anything except going into business."

But we must admit that our amazing technology and industrialization have also contributed to many of the social ills which beset our nation and mankind, and which occupy so much of the thoughts of the younger generation.

And, unfortunately, as the figures cited by Mr. Taylor show, our youth right now has identified business and industry with the "Establishment", and is beginning to lose interest in business as a rewarding career. To use a common expression, youth wants to go "where the action is", or, more accurately, where youth thinks the action is. Its choice of careers will be in those areas where it feels needed, feels it can be creative, feels it can express itself and feels it can make a meaningful contribution toward alleviating the present ills of our society.

Young people, at first acquaintance, tend to view institutions--particularly large institutions--with a certain amount of understandable fear and distrust. It is perhaps the viewpoint of any individual newly confronted with a large society. Yet we are a large society, and as such, must have the necessary institutions to fit that society and do its work. In many areas vast numbers of things must be made, millions of services performed, billions of dollars put to work and millions of people employed. Such is the role of the corporation and big business, and it exists as a necessary part of our society because it does these things on a large scale effectively.

However, the monolithic corporation dominated by elderly men is a modern myth. Most corporations are, in fact, diverse, restless dynamos of activity where the individual talents of thousands of people of all ages thrust at the result. The presidents of most leading corporations are in their 40's, and most of the key men in their late 20's and 30's.

Contrary to old notions, the increased flow of information techniques and communication within the corporation has not necessarily prompted greater concentration of authority and depersonalization. Quite the opposite effect is frequently the case, since these developments make possible the greater decentralization of real authority and responsibility to many, many people. In a practical way, the technical developments of business have made possible a truly relevant role for the individual.

Corporations today look for the broadly educated, adaptable, restless, confident and thinking--but well-adjusted--man for future leadership. In Litton we call him the "entrepreneur".

It is true that America suffers from the same inconsistencies that have plagued the other great societies of man--poverty, ignorance, disease, hunger, war, frustration, despair--existing alongside hope, belief, achievement, joy, progress and satisfaction. But I believe that in America there is a difference.

The productive talent of our society has given us a level of affluence unmatched in history. As some thoughtful critics have pointed out, this is not an unmixed blessing. But if it is not a total blessing, neither is it a total liability. Even the sharpest critics of our affluence admit that it may have given us the resources to attack and solve societal problems around us. And this I believe to be the difference. I believe we have built ourselves technically and industrially to the point where we have both the opportunity to go back and correct our mistakes and at the same time go forward to new achievements. It is a rare opportunity for any society to be free enough, and economically healthy enough, to be able to do this. And I believe we would all agree that the time could not be more opportune.

But when you look at the problems which beset our society, what better and quicker method of solving them is there than by maximum utilization of industry and business in the enlightened application of today's and tomorrow's technology? In fact, I would pose the question of whether, within the time-frame we have, there is any other solution--to poverty, other than improved mass production and distribution of foodstuffs--to pollution, other than vast industrially-applied technology, not only to industrial, but consumer and public pollution--to discrimination, other than by improved training techniques and employment policies which provide meaningful and dignified work--to ghetto housing, than innovative mass-produced housing--to education systems costs, generally, than through new technology in communications and learning media industries.

The list goes on--it includes transportation problems, conservation, etc. My point is that I believe that our free enterprise system, applying industrial technology on an enlightened and priority basis, is the only means of solution to our problems. Certainly, there is no other economic system in the history of the world that has America's track record.

Therefore, when it comes to attacking these problems, the enlightened business, industry or corporation is where the action really is. For example, a few of the activities in which my company has been involved recently are:

(1) Economic planning for undeveloped regions.
(2) Job training for the disadvantaged, followed by job placement.
(3) Air and water pollution monitoring and reduction devices.
(4) Development of new educational and instructional systems involving multi-sensory learning.
(5) Improved food processing and distribution systems.

Here, then, in business is where there lie vast opportunity and challenge for our young people for the betterment of mankind--if they can be shown the opportunity, and if they can be properly motivated.

In an address delivered by Professor Donald Maley at last December's American Vocational Association Convention, he said:

> "If you were to ask 'where is the action for industrial arts?', I would submit that--it is in the areas of major societal problems facing mankind. But more pointedly and specifically, I am suggesting a form of industrial arts which explores the application of technology to the solution of the major social, environmental and operational problems that face mankind."

Professor Maley then goes on to make specific proposals on curriculum. I highly commend this article to you. But I would suggest that included in any new industrial arts curriculum should be courses and instruction which teach the merits of our free enterprise system and our economic institutions. Our students should be taught the differences between our system and other economic systems, and the necessity for maintaining and improving our business institutions in order to apply technology to improve our society. Students must be shown where the action really is and motivated to accept the challenge of taking part in directing business and industry into an even greater involvement in improving our society.

Now this is and should be a joint effort by educators and business. My two specific suggestions are that you contact your local Chamber of Commerce or the United States Chamber of Commerce in Washington, DC, where you can obtain materials on many joint education and industry programs which bear on this subject. The Education Committee of the US Chamber has published an excellent 56-page manual entitled "How to Plan Economic Understanding Projects". Second, you can contact industries and businesses in your school district, and I am sure you will find many companies which would be glad to work with you in your industrial arts curriculum program, utilizing their facilities and staff part-time in advisory or instructional capacities emphasizing understanding of economics and business.

As we enter the '70's, our nation faces tremendous challenges, of which we are all aware. The primary challenge, in my view, is that of proving that our present free enterprise system--the system that has brought us to the way of life we now have--can be adjusted to solve the social and human problems that are plaguing us and especially our youth. Our youth say that there is no need for poverty and pollution in a land of plenty, and they are right. They say that there is no need for distress and discrimination in a land of democracy, and they are right. They say there is no need for such frustration and fright in a land of freedom, and they are right.

The concern of youth with the great issues of our time, the deep dedication of which youth is capable, plus this generation's abiding enthusiasm are the qualities which assure self-renewal of our society on a higher plane each generation--and these are the qualities which must be brought to bear in business and industrial leadership if the great ecological and social problems of our nation are to be solved.

The future leadership of our nation spends more time in the hands of teachers than with their parents. Your responsibility is great. The destiny of Western Civilization as we know it may be riding on the generation of Americans who are now in our elementary and secondary schools. Therefore, industrial arts educators must join now with business and industry in creating out of today's youth an enlightened and motivated future business leadership--a business leadership which, together with leaders in the academic community and in government, will direct our nation to the fulfillment of its destiny of providing for every individual the freedom and opportunity to develop his maximum potential and to contribute to the betterment of mankind.

Mr. Howell is vice-president, Ingalls Shipbuilding Division, Litton Industries, Inc.

Opportunities in a changing society

Patrick Barbour Lyons

I particularly welcomed this chance to speak today before this group. To me The American Industrial Arts Association and this convention reflect a promising approach for coping with the question of how changing technology affects us and our children.

It's a topic to which I've given a lot of thought. I deal with it one way or another almost on a daily basis. And before I say anything further, let me assure you that the last thing I want to do today is tell you how to handle your jobs. I only want to explain what kind of people we are looking for now and in the future and why we need people who are trained to be flexible in the application of their talents.

My objective is to encourage you to concentrate on teaching basic theories and concepts that our future employees can use in learning specific details of their jobs. I hope that we will follow through as soon as we can on whatever insights we come up with today.

In thinking over my part of the discussion, it became increasingly clear to me that we are not only discussing next year's possibilities, or the next decade's possibilities. We are discussing today the careers of people who will just be realizing their full potential 30 years from now.

We crossed a boundary in 1968, and now we're in a brand-new world. To demonstrate what I'm talking about, I'll ask your help. Picture in your mind for a moment the State of Kentucky. What does it look like? Chances are you visualize an area outlined in black, bordered on the north by the Ohio River. Depending on how familiar you are with the state, you might see it criss-crossed with roads and dotted with cities.

Now, I'd like to ask you to picture our planet earth, blue and green and marbled with clouds, rising above the brown horizon of the moon. Ever since the moon walks of last year, most people in America today can picture the earth in that perspective from the moon just as easily as they picture Kentucky.

Here's the point: the vision we have of Kentucky comes from technology. Through the techniques of accurate surveying, aerial photography, mapmaking and printing, we all have a very clear picture of our close surroundings.

Now, again thanks to technology, we have a new vision of ourselves, a new picture of what our home planet looks like as it moves around the sun through the blackness of space. It's an enormously significant vision. Millions of people have lived and died on this planet without seeing such a picture, without having a clear vision (in full color, I might add) of the image that all of us here have in our minds right now.

We can judge the power of such a vision from history. Before modern mapmaking got started in the fourteen hundreds, millions of people had lived and died without an image of even their local surroundings. But when the first good maps of the world began to circulate, people such as Christopher Columbus began to get their first real conception of what the earth was like. It started with a picture, an image in the mind. It ended with the application of this new vision--a whole new age of discovery and exploration of a new world. Thus, both the people of Columbus' time and the people of our time have been given rare opportunities to become true visionaries.

The way we will apply the new vision we have gained from the moon walks will be the drama of the twentieth and twenty-first centuries. One way or another, we and our children will be actors in this drama. The props will be modern technologies. The stage will not be just our country or our state, as in times past, but the whole planet this time, along with the moon and perhaps other planets.

The thousands of engineers and technicians and managers who worked on the Apollo projects were concerned with relatively new technologies. Rockets are new, metals used in them are new, the computers which guide them are new, plastics are new, radio and television are new, even the color photography which brought us back the pictures is new.

Recent as these developments are, however, we seem to take them almost for granted. The way I look at it, we have been broadened by the advances of technology. We are so accustomed to seeing marvel after technical marvel appear on the scene that we have learned to react to new developments calmly, as if we expected no less.

Thus, it is interesting to remind ourselves of how far and how fast we have come with technology, and how quickly our vision has expanded. Arthur Clarke, the astrophysicist and science writer who was among the first to propose communications satellites in 1945, points out that even scientists are sometimes among those who doubt or ignore the speed at which the world can change. Clarke quotes the American astronomer William Pickering, writing a few years after the Wright Brothers made their first flight.

Pickering straightened out the public on what they should expect from the brand-new airplane. Pickering said, "The popular mind often pictures gigantic flying machines speeding across the Atlantic and carrying innumerable passengers in a way analogous to our modern steamships. It seems safe to say that such ideas must be wholly visionary, and even if a machine could get across with one or two passengers, the expense would be prohibitive to any but the capitalist who could own his own yacht."

He was right--the passenger airplane was a visionary idea. Now is the time when we need such vision.

More to our point today, Clarke quotes a Professor A. W. Bickerton on space flight: "This foolish idea of shooting at the moon is an example of the absurd length to which vicious specialization will carry scientists . . . the proposition appears to be basically impossible."

Was Bickerton writing in the seventeen hundreds or eighteen hundreds? No, it was 1926, four years before the birth of Astronauts Armstrong, Aldrin and Collins.

The past nearsightedness of our technological vision affected even the most famous of all scientific visionaries, Jules Verne. He predicted from his nineteenth-century vantage point that in just a thousand years--the 29th century--man would actually be sending and receiving moving pictures through the air! Of course, few believed him when he spoke of this fantastic apparatus which we call television. If Verne had lived just another twenty years, he might have seen the first demonstration of television in 1927.

I hope the purpose of my saying all this is clear: the rate of technological change which we have experienced in the last few decades has far, far exceeded the expectations of some of the best-informed people in the past. These same people were well aware of the technology that surrounded them at the time, and they accepted the products of the Industrial Revolution calmly, just as we do now. But if we had asked the astronomer Pickering how many people would be working in the air transportation industry in the 1960's, or Professor Bickerton how many would have jobs in the space program, we would have been seriously misled.

Clearly, the problem of keeping pace with technology is a serious one, and it's not getting easier. As I've said, our being here today is a positive sign. We are beginning to show our determination not to let our technology outstrip us.

I don't propose, by any means, to discuss exactly how we can do this, simply because I don't know the exact answers. What I would like to do is discuss the problems of keeping up with technology in a general way, from a businessman's point of view, and offer specific observations I have collected on the subject.

My task is to demonstrate the expanding need for men and women in technological fields and to give a broad specification for their background. Again, to avoid encroaching upon your profession of education, I will define this need in terms of my industry's need for flexible people who have a basic general understanding of the theory behind their work in addition to a specific understanding of the job they do. This basic understanding is vital for people to be able to adapt their skills to our changing technology.

But let me begin with technology itself. If we use the customary definition of the word, "the organization of knowledge for practical purposes", we can see that the word technology encompasses nearly all the accomplishments which set man off from other animals.

If we were to graph man's technological progress from the beginning, we would have a very striking curve, especially toward the end, meaning the present.

At our moment in man's history, the curve is going almost straight up. Toward the beginning of history, it has been estimated that it took between ten thousand and one hundred thousand years to double our knowledge. Nowadays, we have whittled that figure down somewhat--it takes us fifteen years to do it, and by now that is a huge quantity to double--and if history holds any lessons, knowledge will double again in less than fifteen years!

But we seem to fail to heed the lessons of history and to anticipate the rate of change. Further, we seem also to fail to predict the breadth of change.

It used to be that our technology was rather simple and obvious in its workings, at least compared to what we have with us now. As an example, recall that the development of the early automobile owes itself in part to wagon- and carriage-makers. For them it was a fairly easy matter to make the jump from one mechanical technology to the next, while the blacksmiths became our mechanics. In a similar way, the Wright Brothers found it natural to progress from the bicycle to the airplane.

Arthur Clarke, whom I mentioned earlier, points out that if we "showed a modern diesel engine, an automobile, a steam turbine or a helicopter to Benjamin Franklin, Galileo, Leonardo da Vinci and Archimedes--a list spanning two thousand years of time--not one of them would have any difficulty in understanding how these machines worked. Leonardo, in fact, would recognize several from his notebooks. But now suppose that they were confronted by a television set, an electronic computer, a nuclear reactor and a radar installation. Quite apart from the complexity of these devices, the individual elements of which they are composed would be incomprehensible to any man born before this century."

I might add that these elements can be incomprehensible to many who were born in this century.

Our technology now is so different from the older mechanical age just past that some have said that we are in the "Second Industrial Revolution". This Second Industrial Revolution is based on far different elements: electronics, atomic energy, new synthetic materials, barely visible and invisible techniques in manufacturing, the life sciences and communications. There simply is no way now that a person can expect to take apart many of our modern devices to see how they work. An automobile mechanic cannot naturally progress to become a television repairman, and a carpenter cannot naturally progress to build an electronically-controlled machine for molding sophisticated plastics.

The problem before us in industry today is that the work of the Second Industrial Revolution is very quickly taking over, replacing the older, purely mechanical, technology. As we move nearer the twenty-first century, the changeover, which is based on an explosion of technical knowledge, continues to accelerate. In order for industry to grow along with this knowledge explosion, we will need people who can expand technology within industry at the same rate. We need not only the most learned specialists to spearhead the change, but also a whole host of support people engaged in a wide range of technological occupations. As I will explain in detail later, each of these occupations would depend first on their basic understanding of the fundamentals of their work, and, secondly, on their specialized skills. This requirement for mobility will accelerate as industry makes technological progress to take advantage of the knowledge explosion.

For examples of this progress, I hope you'll understand if I refer occasionally to the business of making communications equipment. Western Electric is the company I know best, and it is like other modern industries which are changing rapidly as they develop newer products and ways of making them.

Our company was fortunate in one respect--we got started at the very beginning of the so-called Second Industrial Revolution as makers of electrical devices for communications. However, in the past, and continuing even up to the present, we were still involved to some extent with what we might call a visible, partly-mechanical technology. You could see the electromechanical relays and the way they worked in switching telephone calls. While these sets of switches have grown quite complex throughout the years, the logic behind them is still basically a logic you can see. The relays move. You can see the wires.

Now it's getting to be an entirely different story. We are beginning to manufacture a totally different kind of switching equipment, called the Electronic Switching System, or ESS. By the time we get into our full production on ESS, we will have to be fully-prepared to meet the demands of this new technology.

It won't be an easy task. ESS is essentially an application of computer principles to telephone network switching. Instead of the logic of electromechanics, we are now involved in electronic logic. Instead of banks of visible relays, we now have rows of small solid-state circuit packs which perform their functions silently, without moving. We store information as invisible magnetic spots on magnetic sheets and provide operating instructions through invisible computer-type programs.

I can mention one other significant development. At our plant in Allentown, Pennsylvania, we can see the beginnings of complete new methods of manufacturing involving products which were not even conceived of twenty years ago. Since the first transistor in 1947, we have been progressively shrinking the size of electronic components. Now we are at the stage where we can barely see with the naked eye an entire circuit made up of several transistors and other devices. This is the direction that the electronics industry in general is taking, and soon we will be making tiny silicon chips which hold hundreds of transistors.

The manufacture of such devices is revolutionizing the factory. Metals are now being formed into solid state devices molecule by molecule and even atom by atom. We are soldering, assembling, wiring, inspecting and testing under microscopes. Our factories need to be so clean for this type of manufacture that they are beginning to resemble surgical rooms or laboratories.

Computers find use throughout our business as parts of the product we sell, as parts of our test equipment, as parts of our manufacturing process, etc. They are becoming as commonplace as pencils and paper.

To make the changeover into these new technologies, we will be going through a situation that is becoming common in advanced American industry. More than anything else, we will need skilled people. The people who test the electronic switching systems and diagnose problems will have to be thoroughly knowledgeable in solid-state technology. The people who maintain the new, more complicated electronic testing equipment will need a similar advanced knowledge.

Where will these people come from? Where will we get the type of people needed for the hundreds of other complex, highly-technical tasks which nearly all industries are beginning to develop in their factories?

A couple of years ago, industry's competition for highly-skilled tool and die makers became so severe that we had to send some people from Oklahoma City all the way to England to recruit the men we needed. Before that, we had to go to Canada.

Now, you may ask, where do tool and die makers fit into this picture? They are part of the whole field of technologists which are required to support the Second Industrial Revolution. We need many. We train as many as can qualify. However, few qualify for our training program because most candidates lack broad enough basic technical backgrounds.

The word "technologist", as I am using it here, covers a wide spectrum of jobs. It includes the skilled mechanic, the tool maker, the technician, the semi-professional and the professional engineer. Each requires a basic understanding with increasing degrees of knowledge and specialization. Each is a valid, honorable career in its own right.

Well, how are we going to prepare the people in our schools for the Second Industrial Revolution? And a question which must go right along with that one is: How are we in industry going to prepare the people we have with us now, and the people who come to us from the schools, for this same change?

Western Electric and other companies similarly involved in advanced technology have been doing specific training for quite some time, as you well know. The training we have to provide can be quite extensive. In the case of our tool and die makers, we have a three and one-half year course of classroom instruction and on-the-job-training consisting of more than seven thousand three hundred hours of instruction. Even if the new employee has come from a two-year technical school, he will have to spend at least two years training for Western Electric's particular technology.

All the trends in technology and the changes which result from advancing technology indicate that this pattern will continue and probably increase. Engineers, managers, in fact all levels of personnel should now expect to undergo periodic retraining, simply because of the specific changes we will be making in our products and processes during the course of their careers.

Given this trend, and our growing commitment to the responsibility of training our employees for specific tasks, we are beginning to develop some clear preferences concerning the type of man we will want to be hiring in the coming years.

We are getting first of all some ideas about how flexible, adaptable and broadly-trained our employees of the present and future must be, for two reasons. The obvious but very important reason involves what has been called occupational obsolescence. The other involves broad changes in manufacturing techniques. First, occupational obsolescence happens because jobs change as quickly as technology changes. People who must adapt when a new technology makes their old skill or specialty obsolete often have to undergo extensive retraining, from the ground up.

Engineering schools have, in the past years, recognized that the broader and deeper the exposure to the general field of engineering and the theory behind it, the better the engineer will be able to adapt to the changes in the state of the art. In other words, from the very beginning of his higher education, before he specializes, the engineering student gets trained from the ground up. Before he is allowed to develop an especially strong branch, his specialty, he is given some strong roots to support the branch. To continue the analogy, if the strong branch he has developed is cut off, or made obsolete, he has the roots to grow another one far more easily. He does not have to be retrained from the beginning in most situations.

What we have to recognize is that these new rules of the game are beginning to apply to much more than just engineering and the training of engineers. Before this Second Industrial Revolution is over in the years ahead, there will probably not be a single skill or trade which will not be radically affected by our newest technologies. The changes will all be in the direction of complexity, not simplicity; of sophistication, not crudeness. The new skilled technical worker we need now and are going to need in the future will be much closer to today's engineer than yesterday's blacksmith or machinist.

If this is true, then we must admit that what is good for today's engineer must also be good for tomorrow's technicians. The more the technology shifts, the more vulnerable they become to occupational obsolescence. And, therefore, we have a greater need for technicians and engineers who have had a strong general, theoretical foundation, who have been trained from the ground up to be flexible, adaptable people capable of taking on a new specialty if they have to. And chances are they will have to.

I don't mean to imply that we should not continue to give all the special training we can in the trade schools and in industry. We must keep improving this part of our industrial arts education, as we have recently been doing. But we should also consider that industry needs the kind of flexible people who have a sure sense of balance in the middle of rapid changes in their specialty because they've been given a good foundation before specializing.

The other reason that we want this new flexible kind of employee for the future grows out of new basic changes in the way industrial processes are organized. These changes are directly related to the effects of the new technologies of the Second Industrial Revolution.

Briefly, we are beginning to use electronics to link our manufacturing operations into larger and more complex systems of machines. The effects of this trend in the factory are far-reaching. The people on all levels who work with these new manufacturing systems need to develop new ways of thinking which are unlike the very specialized approaches of the past. A link-up of different kinds of machines into a system means simply that there has to be a link-up of specialists who can work with each other and understand each other. They must, in other words, have enough breadth in their training to be well-acquainted with each other's fields. Undoubtedly every industry in America is involved at this moment in adjusting to these changes. And these new methods of organization show every sign of becoming the normal form of organization in the years to come.

I've gone on at some length with this idea because it tends to support my contention that we need a new kind of trained person to go with a new kind of technology. The twentieth century will see the fully-automated factory. The twenty-first century may see the fully-automated industry.

The technicians who will be working in these plants of the future will have jobs far different from the tasks with which we are familiar. They will need to become very familiar with at least the principles which lie behind the new field of systems analysis. At minimum, they will have to be systems thinkers and problem-solvers, with the ability to examine entire processes rather than just isolated parts. Finally, they will have to probe and to think, rather than simply to draw on rote memory.

I feel that the technology we now have in its infancy will demand a kind of creativity, depth and vision that our older technology did not demand. Perhaps we should think about changing the three "R's" from reading, 'riting and 'rithmetic to reading, 'riting and reasoning, so we can instill the ability for flexibility in our young people at an early age.

At any rate, I hope I haven't implied that the new opportunities in industry are somewhere far off in the future. They are with us now in great quantity. So I think the following questions apply to us today as well as to the people in charge of educating and hiring the work force of tomorrow: Are we still training people in crafts or specialties which may already be obsolete? Are we still training people to be specialists first, before they have had a chance to build a solid foundation of general knowledge? Are we still training them to think in narrow, isolated compartments, without giving them a clear idea first that technology is evolving toward interdependent disciplines? Have we begun training them to solve broad problems, and to think? These are the attributes which will be needed by people in the future.

Colleges and universities in this country have long operated on the principle of teaching students how to think, rather than what to think. My comments today have simply been to encourage you to apply this same principle to our industrial and technical courses.

To sum up, I'd like to tie a few loose ends together. Recall Jules Verne's thousand-year error in predicting television. One reason the nineteenth century's greatest visionary could be so wide of the mark was that he had not experienced the history of change which we have experienced. He had been given only a small glimpse of the twentieth-century knowledge explosion.

But our time is different. We have the obligation to be visionaries. Thousand- or even hundred-year errors in our vision are out of the question: Ten-year errors will cause serious problems at the rate we are moving today. Furthermore, we have the obligation to do better than Jules Verne because we have the opportunity to study the changing technology of the past and present, allowing us better to predict the future. We have the chance to prepare ourselves and our children for the coming new age. What we do with children today will decide the course for the rest of the century.

It is sobering to contemplate the fact that the junior high youths we are training today will be reaching the peak of their careers near the year Two Thousand.

I leave you with this question: Have we broken far enough from the nineteenth century in our approaches to preparing twentieth-century youths for careers in the twenty-first century?

Mr. Lyons is general manager of Western Electric, Oklahoma City, Oklahoma.

guidance

Vocational guidance theories and the industrial arts teacher

Herman J. Peters

The industrial arts teacher has the unusual opportunity of being one of those at the forefront of the Now generation. The industrial arts teacher is an expert in the essence of the Now foundation of society, technology in an industrial age. The industrial arts teacher is at the forefront of social change in one's ever-increasing efforts to expand his awareness of opportunities in a widening occupational world. Each one of you is an active participant in many guidance functions. One of the key guidance functions is vocational development. In your work, you have the rare combination of blending the intellect with the manual into an artistry of unexcelled craftsmanship.

This you do to expand individual and social consciousness into the area of industrial technology. You do form many of the horizons from which a student will select a pathway for living. You are at the forefront of guidance. Guidance is active intervention in an individual's life. Guidance is participation with an individual to explore his educational and vocational development in a satisfying way.

Because of your field, its generalities and its skill particulars, you have the opportunity to work with other equally important parts of the educational picture: fundamentals, humanities, vocational education, sciences and adaptive education. You provide an exploratory base for wise selection in the various areas of vocational education. You open gateways for those exceptional children in education, which must be especially adapted to their needs.

After reading some of your literature I am more impressed than ever with the debates and points of view concerning your field--industrial arts. I need not recite them here. However, you have made me think of a number of principles in sorting out our primary and secondary roles in education, whatever our field or particular job assignment. These principles seem to me to be embodied in various theories of vocational development.

Principles. The right to challenge must be preserved in all of learning and in every field of education. It should be kept in mind that to challenge does not necessarily mean disagreement. The challenge may be a search for more meaningful direction in living. Because your field encompasses the wide spectrum of technological awareness, your guidance must be tempered with respect for likes and dislikes of what you present.

We need many alternatives in education. Each has its own dignity, integrity and contribution to individuals and society at large. Within your field, alternatives provide a basis for experiencing the choice-making process in choosing a career based on the substantive knowledge of the vast scope of industrial technology.

The intertwining of knowledge, the interdisciplinary foundations of knowledge, extends itself to the intertwining of vocational interests. From time to time boys and girls vacillate in specific vocational interests, but the specifics seem to have a common thread throughout. This means that each person has many possibilities for successful work experiences; of course, it follows that he needs to know the possible opportunities. Industrial arts expands the choice base for vocational selection.

There is a need for general and specific kinds of learning experiences for choice-making, exploring and decision-making. Industrial arts complements the other areas of education previously mentioned, in providing general and specific learning experiences, e.g., general in the pervasive impact of technology on the culture and specific in the skills attached to certain areas of excellence in performing detailed tasks.

The notion of only one true level of learning, such as verbal, in a technological culture is not only snobbery but explosive. If ever there was a need for a variety of kinds of job learning, there is need now. However, no learning should be so specific as to preclude the application of one's perspective of its importance to society. On the other hand no learning should be so general as to preclude its inclusion in the performance of a job or in the exercise of the nobility of living.

Despite debate over automation and an abundance of leisure time, the work ethic is more important than ever. The nature of work may change, but the need for work in a society committed to environmental quality and justice and peace for all necessitates work. Our basic problem today is that if we had more work we should have less trouble.

The key to implementation of the work ethic in a meaningful life and a fulfilling society is appropriate educational and vocational opportunities. With a wider base for educational and vocational learning, there is more need than ever for professional school counselors to engage in professional counseling and guidance. These counselors work best if in concert with teachers who are guidance-oriented. One area of concern is the more specific nature of selected vocational guidance theories.

One of the earliest approaches to vocational guidance was Frank Parsons' early 1900's views. He recommended study of self, knowledge of the occupational world, then a reconciling of these facts for an occupational choice. Present-day theories seem to expand Parsons' time-tested but perhaps simplified view.

Ginzberg's theory of vocational development. Ginzberg's theory (1) of occupational choice contains four basic elements.

First, occupational choice is a developmental process which takes place over a period of ten years in childhood and adolescence. Second, the process is largely irreversible. Investments of time, money, ego and one's self-confidence during the process make it increasingly difficult to change the direction of the developmental process as the decision-making continues. Third, compromise is an essential aspect of every choice. This compromise exists between interests, capacities, values and opportunities.

The fourth element consists of three periods of occupational choice: a period of fantasy choice characterized by the wish to be an adult; a period of tentative choice beginning at about eleven, first determined by interests, subsequently by the individual's capacities and then by his values; and finally, a period of realistic choice beginning at about age seventeen. This third period consists of substages, (1) exploration, (2) crystallization and (3) specification.

Super's theory of vocational development. In 1953 Donald Super (2) presented the concept of vocational development as being synonymous with the development of a self-concept and its implementation; the process of vocational adjustment is the process of putting a self-concept into practice, with the degree of satisfaction attained proportionate to the degree of self-concept realization. Work is an encompassing way of life, and adequate vocational and personal adjustment results when both the nature of the work and one's way of life are fused with the aptitudes, interests and values of the individual.

People differ in their abilities, interests and personalities. Thus, they qualify for a number of occupations, each of which requires a characteristic pattern of abilities. They have many potentialities; self-concepts change with time and experience. Vocational development is a series of life-stages and substages and the establishment stage. The exploratory stage is the period when the individual seeks the occupation which implements his self-concept. This period has three substages: Fantasy, tentative and realistic. These are similar to Ginzberg's, mentioned above.

The establishment stage consists of trial and stable phases. First, the individual starts in a career, and then through a developmental process, he sees a possible place for himself in the world of work. Second, the individual, who now knows more specifically what he wants to do and where he may be able to do it, analyzes his work to see how he can succeed and institutes such goal-directed behavior. He seeks to maintain this career level.

Super emphasizes that the nature of the career pattern is determined by the individual's parental socio-economic level, mental ability, personality characteristics and opportunities, but he also feels that development through life-stages is guided by: (a) aiding in the process of maturation, (b) aiding in reality testing, and (c) aiding in the development of a self-concept. The process of balance between individual and social factors, between the self-concept and reality, is one of role-playing, whether in fantasy, the counseling interview, or real-life activities. If the individual finds adequate outlets for his abilities, interests, personality traits and values, he will achieve satisfaction.

Tiedeman's theory of vocational development. David Tiedeman (3) views careers in terms of vocational development. Relevance for the anticipation and implementation of each constitutes the essence of vocational development. With regard to each decision in school work, decision-making is divided into two periods: the period of anticipation and the period of implementation or adjustment.

The period of anticipation has four subaspects or stages:

(1) Exploration is characterized by random acquisitive activities in which a number of possible goals are considered.

(2) Crystallization, in which the organization and ordering of all relevant considerations in relation to each of the goals takes place.

(3) Choice or decision becomes imminent as crystallizations stabilize.

(4) Specification occurs when choice readies the individual to act on his decision. Elaboration of the image in the future ensues. Doubts concerning the position dissipate.

The period of implementation or adjustment has three subaspects or stages. There are:

(1) Induction--in which imaginative concerns come face-to-face with reality on the day of initiation. The goals of the individual and society come into a relationship.

(2) Transition--in which a metamorphosis occurs. The mood of reaction changes from responsive to assertive.

(3) Maintenance--in which the assertive need subsides and equilibrium is reestablished. Modification of goals is a part of this phase.

Holland's theory of vocational development. Holland (4) integrates existing knowledge about vocational choice theories. He classifies occupations into six major groups, each having somewhat distinctive tasks, and characterized by a distinctive occupational environment. The Motoric Environment is an example used to describe occupations such as laborers, machine operators, aviators, truck drivers or carpenters; the Persuasive Environment describes salesmen, politicians and business executives. Other environments include: the Intellectual Environment, the Supportive Environment, the Conforming Environment and the Esthetic Environment.

At the time of vocational choice, a person is the product of the interaction of: (1) his particular heredity; and (2) a variety of cultural and personal forces, including peers, parents and significant adults, his social class, the American culture and physical environment.

Values, interests, interpersonal skills and other personal factors determine the life style; the life style heading the hierarchy determines the major direction of choice. Ordering vocational preferences effects the person's range of vocational choice. For example, a hierarchy in which one life style dominates all others results in vocational choice without conflict or hesitancy. An ambiguous hierarchy (one in which there are two or more competing developmental patterns) results in vacillation, making or not making a choice.

Roe's theory of vocational development. Anne Roe's (5) theory of vocational choice emphasizes relationship between early experience, attitudes, abilities, interests and other personality factors affecting an individual's ultimate vocational selection. Her theory is based in part on Maslow's hierarchy of basic needs, where higher order needs appear after lower order needs are relatively satisfied. Early experience determines the direction of the eventual pattern of psychic energies and results in primarily unconscious needs. The intensity and organization of these needs is the major determinant of the direction of motivation, as seen in chosen vocational fields, and the degrees of motivation as expressed in accomplishment. Motivation relates to the occupational group sought in one's career. The significant areas of early experience involve patterns of early experience with parents. The individual's basic orientation with respect to persons later ramifies into patterns of special interests and abilities.

What theories mean to you. Although the ideas above and the selected theories have been presented in miniature, I believe that you can follow with me in an extension of this into my suggestions for your actions as industrial arts teachers.

(1) Through an excitement of your field and based on the substance of technology as a subject matter area, you assist in the development of the self-concept of each pupil in your classes.

(2) Your subject matter of technology, e.g., materials, processes, concepts of construction, can stimulate interest in a variety of occupational areas.

(3) Your active participation in teaching industrial technology gives a continuing emphasis to a constructive attitude toward work begun in the elementary school guidance program.

(4) Your field assists pupils to examine their interests as they move through the various phases of vocational development emphasized in the briefs given on vocational development theories.

(5) If made a part of the school experience of all junior high school students, your subject field can be a guidance base for students selecting avenues in vocational education.

(6) Given to all students sometime in their school experiences, your subject field in its liberalizing understanding of technology can be one basis for a person's career satisfaction. It gives him perspective in the world of work.

(7) As you work with boys and girls in industrial arts and technology, keep in mind the

developmental stages of your students as noted by most vocational guidance theories. Through your understanding of these stages, you can encourage the already-excited, you can stimulate the nonchalant pupil, you can provide a spark to change a potential drop-out into a goal-oriented student.

The time is now for you to implement vocational guidance theory in your industrial arts teaching at all age levels. The time is now for you to engage your colleagues, school counselors, in teamwork. There is no better time than in 1970 to re-assert the value of work and its benefits. Time is a dimension. Now is the time.

> "The moving Finger writes; and, having writ,
> Moves on: nor all your Piety nor Wit,
> Shall lure it back to cancel half a line,
> Nor all your Tears wash out a Word of it"
> --The Rubaiyat of Omar Khayyam, #71

FOOTNOTES

(1) Eli Ginzberg, Sol Ginsburg, Sidney Axelroad, and John Herma, Occupational Choice: An Approach to a General Theory, (New York: Columbia University Press, 1951).

(2) Donald Super, "A Theory of Vocational Development", American Psychologist, 8, 185-190 (May, 1953).

(3) David Tiedeman, "Decision and Vocational Development: A Paradigm and Its Implication", Personnel and Guidance Journal, 40, 15-20 (1961).

(4) John Holland, "A Theory of Vocational Choice", Journal of Counseling Psychology, 6, 35-45 (1959).

(5) Anne Roe, "Early Determinants of Vocational Choice", Journal of Counseling Psychology, 4, 212-217 (1957).

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Career orientation program at the junior high school level

Eugene Woolery

"Where the action is", the theme of the 1969 AIAA Convention, might well be the theme of the 7th- and 8th-grade Career Orientation Program in Dayton, Ohio. This is a program that concerns itself with orienting young people to the World of Work through selected laboratory and classroom experiences using the many resources available from the real working world. From the very inception of the program, the major emphasis has been based on what these young people are doing in constructing, building, manufacturing, servicing, repairing, testing, traveling and seeing, and not relying on verbal skills so prevalent in an all-talk program. How could an effective program be designed to utilize the unique offerings of industrial arts in orienting students to the World of Work?

Educators over the years have been repeating the crying need for a program in the 7th and 8th grades to acquaint this particular age group with a knowledge of the many occupations in today's industrial society. Eighth-grade pupils are going into high school with little or no background in agriculture, business, services, skilled trades and professions, and little thought is given by them to the courses they are about to pursue. Very few have had the opportunity to look seriously and purposefully at any of the working occupations, nor have they participated in the actual practices of a given career. One wonders how many industrial arts students in the 8th grade have watched a carpenter perform in a classroom or how many girls in home economics have watched a dressmaker tailer a suit. How many young people have been offered an extended field trip in the real working world as part of their educational experience--by perhaps spending half a day at a construction site really seeing what is going on? Providing the answers to some of these questions is the challenge accepted by the program here in Dayton, Ohio.

The Dayton program really began when the Ohio State Department of Vocational Education notified school districts that monies would be available for the development of exemplary programs as described in the Vocational Act of 1968. Career Orientation does qualify as an exemplary program.

Realizing this need and the opportunity for industrial arts to assume a more meaningful role in the junior high program, James O. Reynolds, Supervisor of Industrial Arts in Dayton, Ohio, submitted a proposal outlining in detail a student-centered program of Career Orientation. The major features of this innovative proposal may best be described as follows:

(1) Eliminate the "wall-rack, bookend, take-home project" concept in industrial arts and design a new and more work-relevant program around construction and manufacturing. Seventh-graders would be involved in the major concepts of manufacturing and mass production in an active laboratory session. Eighth-graders would spend the year in the significant areas of construction, including architectural drawing, model home building, and the assembling of wall, floor and roof substructures. Masonry, bricklaying and cement work would also be explored.

(2) Extend the "hands on" approach, so successful and unique to industrial arts, to other academic areas wherever possible. When the daily academic topic is discussed, it is not just a pencil and paper exercise but a manipulative exercise as well. Using adding machines in mathematics and assembling an electric motor in science are typical examples.

(3) By scheduling a weekly team period of 45 minutes, home economics and industrial arts activities can be coordinated with other academic disciplines. A joint project, a field trip or a resource speaker is a typical activity.

(4) Make the academic subjects more relevant to the pupil by having the teachers relate the subject matter each and every day to jobs and careers. This "in-class" correlation with school experiences in the world of work is continuous and makes school more meaningful. The pupil sees why it is important to do this or to do that in the classroom. The "why" of school is explored and answered.

Taking the above features into consideration, how did we get the teachers interested in buying this program to the extent that they would actually go back into their classrooms and teach it?

An extensive two-week summer workshop familiarized teachers with the total program, provided the climate for them to develop their own lesson plans, and more fully informed the teachers about the world of work around them.

A typical day at the workshop began with the objective written in large letters on the blackboard for all to see. Outstanding speakers gave presentations in the morning followed by discussion, with the afternoon being spent in teacher preparation of materials. Each day an assigned world-of-work topic, such as agriculture, business, construction, manufacturing, services, government and professions, constituted the agenda. A highlight of the workshop was a day spent as guests of the largest construction corporation in the city. A community college complex, a downtown office tower and a new university field house were seen in the process of construction on the morning bus tour. Participants were luncheon guests at the Engineers' Club, compliments of the Association of General Contractors. As a result of this experience, the teachers became aware of the vastness of the construction industry, the many jobs available and ideas for future classroom topics, an excellent example of school-industry involvement, so necessary in a program like this. The opportunity for sharing of common problems and for talking over different ideas with each other was of great value in the workshop sessions. As a result of this, several participating faculties today are working better as a group in educating young people.

The teachers did extensive work in developing materials and lesson plans and were ready to go when school opened in September. Let's take a look at the organization of the personnel in the program. A city-wide coordinator is responsible for the organization and success of the program. An appointed chairman is made accountable for the program in each school. Duties include conducting weekly meetings, distributing materials, coordinating activities and keeping a finger on the pulse of the program. A report, written by the teachers detailing specific activities, is compiled by the school chairman and sent to the city-wide coordinator every two weeks. It is important to stress that this is a teacher's program with the teachers doing the major amount of the work. Principals, counselors and assistant principals are indeed important from a supportive standpoint. The principal sets the tone of the school and does the prodding along by offering encouragement and attending weekly planning sessions whenever possible. One principal, with the cooperation of his brother-in-law, a successful nurseryman-farmer, arranged an outstanding field trip to a farm to see potato processing and packaging in operation. Administrative participation such as this stimulates the program, and teachers are very much aware if the principal is genuinely interested in their efforts to make the program operational.

The guidance person administers vocational interest tests and aids in the selection of resource materials. His knowledge of the availability and suitability of films, filmstrips and guidance kits can be very valuable in this program.

Let's now look at the specifics in the program and what is really happening to the students. The industrial arts laboratory will reveal a modern general shop outfitted with jigsaws, grinder-polisher, drill press, disc and belt sander, 4 x 6-ft. maple benches and a comprehensive array of hand tools. The 8th-graders are constructing model homes to 1/4-in. scale, not as cardboard replicas with scissors and paste, but from 1/8-in. plywood involving industrial arts equipment and hand tools. Many of the homes are brightly painted and landscaped with trees, grass and shrubs. Interest during the month of February is at a particularly high peak since students are aiming for the $100 prize given for the best school exhibition of model homes at the local Home and Garden Show. Upon completion of the model homes, pupils will begin team activity in the building of full-size house sections, which will include the work practices of the trades employed in home construction. One teacher is planning with his students to construct a full-size home on an enclosed school courtyard. Imagine the interest this will create in the neighborhood!

Typical 7th-grade activity is concerned with the important elements of manufacturing. An example is a model truck that serves not only as a product for mass production, but also lends support to a transportation unit in social studies. A field trip to the International Harvester Automated Truck Plant in Springfield, Ohio, further enhances the manufacturing-transportation concept.

Home economics and industrial arts classes joined together to create a special Christmas project. A small jar, topped with a styrofoam head and decorated with colorful cloth, was transformed into a beguiling Christmas figure. The jar was filled with candies made by the girls in home economics, the fabric was woven on a small loom manufactured in industrial arts, with the final assembling being completed as a team effort between the two departments.

Additional happenings are giving new life to the academic areas. In mathematics, punch cards are being used to duplicate the practices of data processing, and many new business forms are being studied relating mathematics to actual work practices.

Horticulture is one of the important features in the science program, with each pupil growing a flower and a vegetable. A 3 x 4-ft. garden plot encased in a metal pan enables students to dig right in with soils, fertilizers and plants--an opportunity denied many urban children.

Electrical and mechanical kits create pupil interest, making science more realistic with regard to the roles that the electricians and mechanics play in the working world. An innovative idea was instituted in social studies with the "hands on" concept. A class of thirty students selected a model car they wanted to build on a mass production basis. Thirty identical car kits were purchased, and a manufacturing organization was set up to duplicate an auto assembly operation. The concepts of warehousing, interchangeability of parts, supervision and inspection were incorporated into the activity. One can well imagine the enthusiasm displayed by this group of youngsters as the model cars were being constructed.

In all instances, the teacher is the heart of the Career Orientation Program, providing the leadership, arranging activities and helping with projects.

Students are involved in a program that is more than just talk.

Mr. Woolery coordinates the Career Orientation Program for the Dayton (Ohio) Public Schools.

World of work and occupational education at the high school level

Robert C. Bills

In his definition of industrial arts, Delmar Olson states:
"Its purposes are to acquaint the student with his technological environment and to aid him in the discovery and development of his own human potential."(1)
Certainly if we are to help a student develop to his fullest potential, we should help him make some of the occupational decisions which will so greatly affect his development after he leaves school.

The Educational Policies Commission feels that for an education to be of value to a student, one of the major things it should do is "equip him to enter an occupation suitable to his abilities and offering reasonable opportunity for personal growth and social usefulness." (2)
To do this it would seem logical that we teach students something about the various occupations available and help them in deciding on one suited to their abilities.

It is the purpose of this report to provide some suggestions and activities for implementing information on occupations and the world of work in high school industrial arts classes. I hope the suggestions will lead to more ideas on how we in industrial arts can better help the student find an occupational area for which he is or can become well-adapted.

There are many abilities or competencies which students should develop. Some are basic, such as the ability to read, write and study. These basics should be developed in all subjects, including industrial arts. There are many other abilities which we also try to include in industrial arts, such as the ability to solve technical problems, to experiment, manage, operate, produce, engineer, invent and design, to name but a few. All occupations require one or more of the abilities mentioned.

It seems that the role of industrial arts should not only be to try to develop these abilities but also to point out to the student occupational and industrial areas where the abilities which he has are in demand. Thus I believe we should try and analyze at least the major occupational fields for the major abilities a student should have if he expects to be successful in that occupational category.

With over 25,000 different occupations, it would be virtually impossible for us to discuss each one in the classroom. For this reason it would seem that the only practical way to deal with such a large number of occupations would be to classify the abilities, because there seems to be fewer major ones, and to decide what abilities different major occupational groups need.

Time does not permit me to go into great detail about all of the various ways this grouping can be done. Instead let me give you one example of a way this could be done.

You could take and classify the abilities first into major groups, such as the ability to organize, create, operate, maintain, manage, experiment and solve technical problems. Now that you have narrowed the abilities to the major classifications, you may look at each major ability and decide what supporting abilities for each are needed. For instance, a manager should probably have the ability to deal with many people, to make quick decisions and, depending on his exact industrial position, several other abilities as well.

Thus when a boy comes to you and says, "I want to be an engineer," you can congratulate him for making a choice and then proceed to help him discover the abilities basic to engineering, such as being able to solve technical problems. If he decides he has these abilities, you should help him discover what type of engineer his specific abilities best suit him for. Once this is done he should also start thinking about what industry, such as automobile, oil or airplane, he would like to work for, since often this could have a direct affect on narrowing his choice of types of engineers which he would like to be. In some instances it may be a good idea to make this industrial choice either earlier or later in the selection process.

By approaching the student in this manner, what you are in effect saying to him is, "I think it is good that you made an occupational choice. Now that you have made this choice, what industry would you like to perform this occupation in, and do you have the ability to perform this occupation?"

If the boy, as in many situations is the case, then becomes unsure of his choice or abilities, you may through various classroom activities help him discover if he has the abilities he has discovered he needs.

In any event even if he does not have the abilities for that occupational choice he should at least have a better idea of what abilities he does have and in what types of occupations he would find a use for his abilities.

Let me give you an example of how I was able to provide an experience which I was able to use to let the students discover something about their own abilities and how this ability or lack of it could affect their occupational choice.

The lab had some new experiment tables which needed to be assembled for my electronics class. We had been discussing mass production and the abilities one should have to work on an assembly line, which is common in many mass production operations. The boys felt that it was an easy way to make a living and required little ability.

I set up the class on an assembly line basis, putting the tables together. After only 20 minutes several complained they were bored and tired of their job. So I let each of them try assembling a table by himself.

At the end of the period I pointed out that although the boys obviously had the ability to assemble the tables, they did not have the ability to perform one task repeatedly without becoming bored with it quickly. In this simple activity I was able to help them discover something about themselves which could prove useful in their deciding on an occupation. I also was able to use this activity in pointing out advantages and disadvantages in assembly line production. I mention this to make the point that occupational information can be blended in and become an integral part of your classwork and lab activity.

As you may have noticed when I discussed abilities earlier, the examples I gave were of general sorts of abilities, such as the ability to organize, create, etc. There are reasons I have left these abilities broad rather than narrow.

First of all, our whole society is changing at a fantastic pace. This includes almost all occupations. If we look for and indeed try to develop narrow specific abilities, we most likely will be teaching something which will be out of use by the time our students enter their chosen occupations--that is, assuming we have the equipment to teach a trade, which in most cases we don't.

For example, one of the major abilities usually stressed in drafting is proper line weight; however, with the advent of modern copying and data storage devices, companies find inked drawings much better for making reproductions than pencil drawings. In fact there are even computer-linked drafting machines in use which minimize the need for many of the old drafting abilities or skills. Wouldn't the ability to communicate ideas through the use of graphic symbols and representations be of greater importance when considering fields in which we usually think of drafting playing a major role?

I have chosen several activities which I have used or seen used with success which I would like to bring to your attention.

It is not my intention that you should copy or use any one of these activities. What I do hope, as I mentioned earlier, is that you gain from these examples ideas of ways in which you can introduce occupations and the world of work into your present program. Now let's look at some of these examples.

One teaching aid which is available to all of us is the newspaper. This activity makes use of a local paper, a paper from a nearby city and perhaps a paper from another part of the country. Go over the "Help Wanted" section of each paper with the class. You may wish to compare the different occupations available as to their availability in different areas, the pay, and the types of companies or firms which make use of various types of occupations. Also you might point out any requirements which might be listed for these occupations. If you wish to involve the students more, you could have the students prepare charts illustrating some of this information. This type of activity helps bring realism into the classroom. Students often complain of the irrelevance of school. By using current newspapers as an information source you help point to the direct relationship between your course and the real world of work. If you are teaching a specific technical area, such as electronics or drafting, trade journals from this area could be included with the papers. In this case the study would be limited to occupations connected directly to your technical area.

The Dictionary of Occupational Titles, which lists some 25,000 occupations and briefly describes them, could be used as a reference to answer questions as to what various occupations involve.

Another way to bring the real world into your classroom is with a guest speaker. Some suggestions in this area would include a representative from your local employment office, a personnel man from a local industry or a man whose profession is one currently under class discussion, such as an engineer or electrician. I have found that these talks usually are better if you are able to meet the speaker some time in advance of his presentation and structure the talk as to length, specific areas to be covered, and level of difficulty.

You could have the students work out a list of questions they would like to have answered by the speaker. If possible, try to include these questions when talking to the speaker so that he will include this information in his program. I have found that in many cases the speaker can provide you with a wealth of material for future classes. For instance, a personnel man was able to furnish sample job application forms and job description sheets which provided a basis for a class discussion as to what specific information many firms want before considering a person for a job.

Many of the most desirable occupations require advanced education or some special training after high school. An activity which should be of special interest to juniors and seniors is to investigate various schools, including courses, entrance requirements, etc. You may have the students write the school for its catalog and any other information they may be interested in. Your school guidance counselor would make a good guest speaker as part of this activity. At least arrangements should be made so that the students will be able to make use of the facilities your guidance office has in doing their study. This also might make your counselors think about what we do in industrial arts and broaden their view of us as a subject area. Some students may wish to investigate opportunities for special occupational training in the various military services. Another possibility in this activity is to investigate any special training programs operated by some companies. Also you may wish to discuss how some unions operate apprentice training programs. This activity will better enable the student to understand the education requirements of many occupations and may help him decide on what post-high school education he will pursue, if any.

One simple activity which usually provides a good cross-section of the types of occupations common in your community is to have each student report on the type of work his parents or someone he knows very well does.

You may wish to have the reports very brief and limited, such as giving the job, company, responsibility, approximate number of other people who do this job in that area or company and the requirements one must meet to get this job. If time permits, the reports could be the start of more extensive class discussions about each job or major occupational area.

Up to this point all the activities I have discussed were relatively simple and could be plugged into most average industrial arts courses.

Now I would like to discuss an activity which if carried to its maximum potential is a full course but can be altered to fit in as a part of your present courses.

The idea is by no means a new one: It is to have your class form a company and produce a product. It is not my purpose here to discuss all the pros and cons of this activity. What I do want to do is point out the tremendous opportunities in teaching about occupations and the world of work this activity offers.

By having the students study and fill the positions available in their company, they learn first-hand what abilities are needed and the opportunities in such occupational areas as management, engineering, designing, sales, marketing, production, maintenance and many others.

Of special interest in providing occupational information would be the setting up of employment procedures for these positions in the company. In this way students would have the experience of writing a resumé of their qualifications, filling out an application blank and having a personal interview, all common procedures in obtaining a job.

I have only mentioned the most obvious ways in which this activity can be beneficial in teaching about industry, occupations and the world of work. I am sure many of you can see countless ways in which you can relate to and aid the student in making his occupational choice by using this activity as a base.

Although these activities help show types of occupations and qualifications needed to fill them, it does not necessarily mean it will become clear to the student what occupation he wants to pursue.

In many cases only detailed study by the student of the area he is interested in will help him make a final choice, and even then he may be wrong.

In my opinion, what we in industrial arts can best do is to provide activities, such as those I have discussed above, which help the student learn about the occupational choices available and provide him with enough information so that he will be able to explore the area in depth himself.

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Managing a safe environment in schools—the safety engineer's viewpoint

Ralph J. Vernon

When I think of an environment, I think of a "work sphere". Such a work sphere may be a complete school plant or a complete manufacturing plant, a shop or laboratory in the school or a department in a plant, a machine operation in the shop or a machine operation in a plant. In this paper I choose to think of the complete school plant as the "work sphere" and to be concerned with the management of that operation to produce optimum performance--specifically optimum "safety" performance.

I would like for us to consider these points:

(A) The components involved in managing a safe environment
(B) What we really mean when we use the terms "injury" and "accident"
(C) What some of the effects are of "accidents" on our society
(D) Injury experience in industry
(E) Injury experience in schools
(F) The young employee in work environments

The components in any well-balanced program for managing a safe environment will require some activity in six points of a basic plan. In the school, these six points are:

I. Administrative support and direction
II. Safety organization
III. Teacher activity
IV. Student education
V. Control of hazards
VI. Medical program

We will look at these six points in some detail. As we do, you will recognize that the degree of activity in each of the six points will vary according to the nature and extent of your operation.

Administrative support and direction. When management, and here I refer to the school superintendent, the principal and the supervisor, is sincerely interested in safety, expresses a willingness to cooperate in safety activities and supports and directs safety programs, the desired result will usually be obtained. The most successful safety programs are those in which management has participated and has continued to show its interest in the safety of its employees or students. Four of the most effective ways in which management can express interest are:

(1) Issuing a statement of school policy. One of the most important steps to be taken is the publication within the school of a policy statement over the name of the superintendent. This statement, in general, emphasizes his interest in accident prevention and requests the cooperation of all students and staff in the effort. It should clearly outline the responsibilities which have been delegated to individuals or groups.

(2) Establishing an Executive Safety Committee. The function of this committee, which could be composed of principals and supervisors, is to interpret school policy in the administration of the safety program. This committee acts as a liaison between the superintendent and the staff. It makes decisions where it has the authority to do so and makes recommendations to the superintendent in matters which are beyond the scope of its authority. Where the school organization is so large as to make immediate control of the program by the top executive impractical, the Executive Safety Committee performs a vital function.

(3) Attendance at meetings. The attendance at safety meetings on the part of members of top management is a very significant indication of their interest and concern for safe operations.

(4) Completion of recommendations. A certain percentage of valid recommendations, because of scope, cost or other factors, will require the superintendent's approval. His insistence that these and all other appropriate recommendations be completed is a source of tremendous gratification to the groups and individuals that have proposed them and is one of the best ways of encouraging their continued effort and interest. It is a way in which management can unmistakably demonstrate support of the program.

Safety organization. It is my basic philosophy that safety should be an integral part of an organization's method of operation. To accomplish this it is usually necessary to assign responsibility for planned safety activities to an internal organization created for this purpose. The structure of this organization could include:

(a) Safety coordinator
(b) Safety committees
(c) Inspection committee
(d) Special committees--Fire, safety suggestions, special school activities, etc.

The functions could include a plan for identifying safety problems. In order to direct its safety efforts effectively the school should recognize and utilize all available sources for identification of accident problems, including:

(a) Accident occurrence data--District-wide records by school, division, activity, lab, etc.

(b) Inspection procedure--A comprehensive safety program should include frequent inspections to detect unsafe conditions and practices. No area should be exempt from inspections although special attention should be devoted to the more hazardous areas. The inspections should be thorough, of sufficient frequency, and corrective action should be taken. Inspections can be considered as being comparable to the physician's medical examination; they are both fact-finding tools used to determine what is correct and what may be in error and the corrective action needed to alleviate defined conditions.

(c) Accident investigation procedures--The purpose of such investigations is to discover the causes of the accident and to correlate them in such a manner as to indicate the solution to the situation which was responsible for the accident. Solutions may include engineering revision, enforcement of regulations, improved education of staff and students or any combination of these.

The superintendent or his appointee should review the investigation reports from three standpoints: (1) to be assured that reports of good quality are being made, (2) to learn what corrective action has been recommended and (3) to decide how and to what extent such recommendations should be implemented.

(d) Outside sources--National Safety Council, members of professional organizations including the American Industrial Hygiene Association and the American Society of Safety Engineers, local fire department, etc.

An additional function is the development of a system for corrective action. In such a system, recognized problems should automatically receive the necessary attention. This involves seeing that the problem is referred to the person or committee with the responsibility of correcting it and seeing that it is followed to completion.

Teacher activities. It is generally accepted that the teacher is the person ultimately responsible for the control of accidents. He is closer to the students and is best informed regarding operating methods and conditions. Accordingly, his active participation in the safety program is essential for success. It is equally important that in the exercising of his responsibility he develops a sound knowledge of safety techniques. These techniques can be developed in part by serving on school or community safety committees, investigating accidents, completing inspections, developing safety specifications and developing work methods.

Student education. This could include indoctrination as to why the school is interested in student safety, what the school and teacher expect of the student, and specific job instructions so that the student knows the approved manner of performing the job, including any special jigs or fixtures, handling specific materials, and the availability and use of personal protective devices. The successful use of safety films, demonstrations and printed materials is a part of student education in safety. It is possible that parents should be included as an "educational measure" in the completion of "work permits" for specific operations or machines that their son or daughter may be operating.

Control of accident hazards. Control of accident hazards includes these major points: Safeguarding machines and equipment; establishment of safe environment; establishment of safe methods; and control of fire and explosion hazards.

Safeguarding of machines and equipment. The hazards presented by electrical and mechanical equipment and by pressure apparatus are among the most severe of all the hazards encountered in industrial operations, and I suspect this is true in schools. These important points should be considered:

Point of operation on machines--Guards should be provided and in use on all machine points of operation. These guards or devices should be designed and built in accordance with recommended standards. We must recognize that this may require special guards for some operations.

Mechanical equipment other than point of operation--Such guarding is important on mechanical power transmission, conveying and other mechanical equipment as well as on production machinery.

Pressure apparatus--Standards for equipment safeguarding must be strictly adhered to if serious or catastrophic accidents are to be prevented. High-pressure equipment should be regularly inspected by qualified inspectors. All low-pressure equipment should be properly operated and equipped with necessary safety devices, and air compressors should be kept drained and lubricated.

Portable electrical equipment--Portable electrical equipment should be of standard design. Provisions for automatic grounding are necessary if electric shock accidents are to be avoided.

Hand tools--The provision of a good quality of the right types of tools with facilities for repair and replacement is necessary to prevent hand tool injuries to students. Important also is the degree to which the tools are maintained. I am not sure that students can be expected to maintain these unless they are closely supervised.

Establishment of safe environment. This section deals with physical conditions or what might be called the "environment" in which the student works. An evaluation of this environment, represented by the following principal elements, is therefore important in determining the accident potential.

Layout--Aisles, machines, storage, etc.--Floor space allotted to machines and equipment should be adequate without encroaching on needed aisle and working space. Aisles should be wide enough for all traffic requirements and should be properly marked. Storage facilities should be ample to meet requirements without overloading of racks or overflow of materials into areas designated for other purposes.

Floors should be of proper design and construction to meet traffic, loading and working requirements, and should be properly maintained.

Stairs and steps should have treads of sufficient width and with anti-slip characteristics, be of satisfactory slope, have proper hand rails and be in good structural condition.

Other working surfaces--Ladders, scaffolds, etc.--These should be in good physical condition, properly guarded and properly designed for the use to which they will be put.

Lighting should be of sufficient intensity for the work to be performed without undue glare and shadow, with equipment properly maintained and serviced. Both local and general illumination should be considered.

Electrical shock hazards--Evaluation of this will be principally from the standpoint of adequacy of dead metal grounding, guarding of high voltage equipment and avoidance of substandard temporary wiring.

Housekeeping includes the regular cleaning of all parts of buildings and equipment on a regular schedule, prompt removal of waste and trash and immediate clean-up of spillage and breakage. Special attention should be given in bad weather to entrances and exterior stairs and walkways. Materials in process, tools, etc., should be kept in designated places.

Occupational health hazards--Exposure to significant noise, atmospheric contamination, radiation and hazardous chemical substances are among the principal health hazards. The degree of control of these hazards should be considered.

Establishment of safe methods. Safe methods, in the sense in which it used here, refers to the physical technique by which an act is performed and also to the adoption and maintenance of mechanical aids, where appropriate, and the use of personal protective equipment, where needed. They refer also to seasonal, special and infrequent tasks.

Equipment maintenance--A preventive maintenance schedule is a good investment in any safety program. This calls for adequate equipment inspection, prompt repairs and a good maintenance staff.

Materials handling--Manual--Receiving, production and shipping operations should be arranged and conducted to minimize the need for excessive rehandling or manual handling of heavy objects. Students should be trained in proper lifting techniques; extra students should be used on heavy lifts where needed. I will have some additional remarks later on this subject.

Materials handling--Mechanical--Most of the handling, particularly of heavier objects, should be done mechanically; handling equipment should be reasonably modern, efficient, safe to operate and students sufficiently trained in its use.

Traffic control--Traffic control should consider the movement of mobile equipment both inside the school and in the yard. Aisles and traffic ways should be properly marked and kept clear for passage of vehicles and pedestrian traffic; adequate precautions for blind corners and intersections should be in force; and recognized good practices relating to speed control, load distribution and operation training should be standard operating practice.

Personal protective equipment--Personal protective equipment should be available for use and adequate to suit the exposure. Its use should be enforced where required. Adequate facilities and personnel should be available to maintain the equipment.

Seasonal or infrequent hazards--Proper planning should be given to avoidance of hazards which could result from maintenance, repair, replacement and installation projects which occur irregularly and which are not covered by the normal procedures.

Control of fire and explosion hazards. Although the control of fire and explosion hazards may normally be considered the responsibility of the fire department or the custodial staff, the teacher should assure himself that the more obvious hazards have been recognized and controlled.

Flammables--Considered in this section should be recognition of the presence and use of more than formal fire hazard materials, explosive dusts, and combustible raw materials and products. Control measures commonly used are proper storage and handling equipment and procedures, appropriate fire extinguishing equipment, surveillance of hazardous areas by means of watchmen or automatic detection devices, automatic alarm systems and the planning of firefighting procedures.

Ignition sources--Under the conditions listed above, presence of possible sources of ignition is important in fire prevention, and these can usually be detected. Unauthorized smoking can be a symptom of ineffective fire prevention control. Awareness of substandard wiring and poorly maintained electrical equipment is important. Heating equipment should be properly installed and maintained. Welding should be carefully supervised with thorough follow-up watch service for possible subsequent fires. Any evidence of disregard of possible fire sources should be considered as poor control.

Catastrophe--A poorly controlled "catastrophe" situation would be one in which persons, especially in large numbers, are exposed to the possibility of injury or death from fire and explosion while in a confined, poorly protected area without adequate exit facilities. Good control of any catastrophe exposure would include the fire prevention, detection, alarm and extinguishing devices described above, the provision of adequate, easily-accessible exit facilities (doors, stairs, horizontal exits), and a regularly-rehearsed plan of fire-fighting and evacuation.

Medical program. While I appreciate that this is the prerogative of the medical professional, I believe they would agree that these should be the minimal acceptable controls:

(1) A School Medical Policy prepared and supervised by a physician

(2) Placement procedure to determine if a student is physically capable of safe performance in the school environment

(3) An awareness of any needed medical control for specific exposures

(4) An adequate record system, including first aid records, for all injuries.

Finally, the success of the whole program depends on whether management is, in fact, authorizing and following through the suggested corrective action when unsafe conditions and/or methods have been brought to their attention. Management should remain abreast of the accident experience in their operations and should periodically call for an evaluation of their safety program to assure continuing success.

Now that we have, hopefully, generated some thoughts pertaining to a program designed to produce optimum safety performance, let us consider some philosophical aspects of safety.

The term "accident" cannot be equated with the term "injury". An accident often precedes an injury, but all injuries, at least in the occupational sense, are not preceded by an accident--for example, damage to the respiratory tract from some toxic chemical. An accident can be defined as an unplanned interruption of an activity which may or may not result in injury, damaged equipment or damaged material (but has the potential to do any of these) and is invariably preceded by an unsafe condition or an unsafe act or a combination of these. An injury is a specific impairment of body structure or function caused by an outside agent or force, which may be physical, chemical or psychic.

When we speak of "accident" analysis data, we are usually referring to "injury" analysis or data from which we attempt to extract "accident" facts. This is often very difficult and can produce misleading results.

Most injury statistics are developed into "Disabling Injury Frequency" and "Severity" data, which may be misleading if used alone in evaluating success in controlling accidental occurrences.

H. W. Heinrich indicated that for one disabling injury there was a ratio of 29 non-disabling injuries and 300 accidents in which no injury occurred! Again, if we use disabling injuries only in attempting to appraise accident performance, we may make mistakes.

What effect do "accidents" have on our society? I am not sure that I can give you specific answers, but we can examine the situation together. We hear references made to our annual, monthly or three-day weekend accident tolls, and we pause and give lip-service to efforts directed toward reducing the large number of accidental fatalities and injuries we hear about. The annual accident toll looks like this:

Killed	104,000
Injured	52,000,000
Work days lost	90,000,000
School days lost	11,000,000

Now, who is injured? What segment of our population is most affected by accident injury? Let us compare "accidents" with some other major killers. For all ages of our population, we find this picture: cardiovascular diseases are the greatest killers, cancer ranks second, and accidents rank third. When we consider the youthful segment of our population, i.e., ages 1 through 37, accidents exceed all other causes combined as killers at these ages.

As to the economic impact, it is astronomical. Such a dollar drain places a burden on the producers of our gross national product--a burden which we can ill-afford.

How are the public schools performing in accident prevention and control? Recently, while collecting some research data, I was able to secure some information on injuries in the public schools of Texas for an academic year. It was determined that only 2.8 percent of the injuries occurred in industrial arts, vocational education and science labs. Indeed, you must be doing an excellent job. However, perhaps we should consider the number of injuries. A total of 93,381 injuries were reported, and 2,647 of these occurred in industrial arts, vocational education and science labs.

Industry has made giant strides in many instances in injury control. Many factors have contributed to this achievement, but the picture is not as good as it often appears. One large operation with which I am familiar develops approximately 33,000,000 man-hours annually, and they have had a continually decreasing disabling injury frequency, but their total injury frequency has fluctuated with employment fluctuations. I think industry is making increased efforts today to control their interruptions to production, or accidents, and resulting losses. Now, if industry is successful, we should find that occupational injuries to young employees entering the work force should be minimal because of better control by industry and good safety instruction in public schools. But, what happens in the work environment? I think this is a valid question because it is reasonable to believe that we are preparing our young people for productive pursuits. A study was completed in 1962 which gives us some insight into the injury experience of employed young people. Eight states cooperated in providing data for two age groups: under 18 years of age and 18-20 years of age. The only injuries studied were disabling. Table I shows the injury experience by age and type of industry. Note that manufacturing injury experience accounts for 34 percent of the total, and this should be important to you.

TABLE I

Type of Industry	Under 18	18-20	Total	Percent
Manufacturing	184	370	554	34+
Wholesale and Retail Trade	312	168	480	30+
Construction	67	107	174	11
Service	101	53	154	9+
Agriculture, Forestry, Fisheries	96	5	101	6+
Other	43	66	109	6+
	803	769	1572	

TABLE II

Activity When Injured	Under 18	18-20	Total	Percent
Manual Handling	279	289	568	36
Operating Powered Equipment	127	179	306	19
Bodily Movement	142	120	262	16
Using Hand Tools	133	118	251	16
Other	117	94	211	13
	798	800	1598	

You will note that manual handling accounts for thirty-six percent of these disabling injuries. In industry, we estimate that twenty-five percent of disabling injuries can be classified as manual handling.

May I ask some questions? In the public school shops and laboratories, are we teaching safe materials handling as well as safe hand tool use? In the metals lab, when that husky young man attempts to lift an anvil, do we smilingly look in the opposite direction? I suspect that we are not teaching this aspect of safe operations. In fact, two books on safety education have recently crossed my desk. Neither of these gives more than cursory mention to manual materials handling even though one of them discusses the previously-mentioned study in some detail.

In summary, the development and management of a safe school environment is important to educators, to students and to the communities. Not only is it important while the student is in school; it should be even more important as students are prepared for a safe, healthy and productive life. At this very moment, 65,000 hospital beds in this nation are occupied by victims of accidental injuries. What do you plan to do about it?

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Managing a safe environment in schools— the industrial hygienist's viewpoint

Andrew D. Hosey

It is always wise to begin a discussion such as this by defining a few terms and setting the stage, so to speak, for what follows. Industrial hygiene may be defined briefly as the science and art of recognizing, evaluating and controlling those environmental factors or stresses which may cause sickness or impair the health and well-being or workers. The terms industrial hygiene and occupational health are often used interchangeably. The latter term is broader and refers to the health of workers engaged not only in industrial operations, but also in agricultural activities, in service trades and in other occupations.

Occupational health hazards refer to any situation where the health of workers may be impaired because of exposure to toxic materials and physical agents in the working environment. For purposes of comparison, safety hazards usually refer to conditions in the work place which may give rise to traumatic injuries unless proper safeguards and appropriate procedures are adopted and followed. To state this differently, failure to follow safe practices usually results in an accident that causes immediate bodily injury. On the other hand, exposure to toxic materials and certain physical conditions, excepting massive accidental exposures, may require days and even years to produce an impairment to health. Thus, occupational diseases usually are not nearly as dramatic as accidents.

The purpose of my presentation is to acquaint you with potential occupational health hazards, the types of exposures, and the measures commonly employed to control these hazards.

Public schools, through their classes in industrial arts and vocational shops, are keeping abreast with our present space age technology. Subject areas included in courses offered at junior and senior high school levels cover the alphabet from A to Z--art classes and aircraft engine repair to zymurgy. Likewise, the potential health hazards involved are quite varied in school shops, just as they are in modern industry today.

Let me emphasize at the outset that the health hazards encountered by students in our modern and well-equipped school shops are very much like those encountered in industry. The only major difference between school shop and industry hazards is the degree of exposure. It is not likely that pupils will encounter actual hazards while working in school shops because their exposures are generally of short duration--one or two hours per day for three to five days per week. But there will be exceptions based on individual susceptibility or acute or intense exposures.

As you well know, many occupational diseases, and sometimes even deaths, are the result of careless work habits, thoughtlessness, or lack of knowledge concerning the dangers of exposure to certain materials or physical conditions. The teacher must therefore use every opportunity to stress the importance of careful work habits, as well as safety practices to minimize exposure to potential health hazards.

Now, what are some of these hazards to which pupils are exposed and which may result in health impairment depending upon the degree of exposure? Again, just as in industry, they may consist of dusts, fumes, gases, vapors, mists and physical agents or combinations of these. A modern printing shop, for example, like one in a Cincinnati school, can include most of the above categories. Lead fume is generated by the monotype and linotype machines and remelt pots. Lead dust is usually found around the remelt pots where dross is removed and sometimes thrown onto the floor. Vapors of various solvents are released in printing shops from the various inks used in printing and the materials used for cleaning type and ink rollers. In previous years, carbon tetrachloride was the chief cleaning solvent used in print shops, but today most shops use a less toxic solvent. Most printing shops use gas flames to eliminate static electricity as the paper zooms through the press. Others use a radioactive static eliminator, which may create a potential health hazard from a physical hazard--ionizing radiation.

Auto repair shops also involve certain hazards to health. These may include lead dust during valve grinding; carbon monoxide gas during tuneups; solvent vapors from cleaners and lacquers; chromic acid mists while electroplating bumpers and other metal parts; fumes from welding frames; and another hazard, dermatitis, from epoxy resins used as auto body fillers.

Students in school electronic or physics shops may be exposed to physical agents. A few examples include X-rays and ionizing radiation from high-power radar tubes; ultraviolet light from arc welding and sources of "black light"; and now the school shops are experimenting with lasers and microwaves. These are just a few of the potential hazards involved in the electronic shops in schools.

Another example will serve to illustrate the type of potential hazards involved in school shops. Many schools have classes in ceramics and pottery-making. Principal hazards include the following: (1) Dusts from clays (free silica which can cause silicosis), and from the materials used in glazes such as lead and cobalt; (2) carbon monoxide gas from the gas-fired kilns; and (3) ultraviolet radiation from a quartz tube, used as a heat source in some kilns.

A final potential hazard to students I want to discuss briefly is noise. Most of you have read in the newspapers, popular magazines and technical literature that workers and citizens alike are being exposed to more noise every day. Even our homes are becoming more noisy as new appliances are installed and used. To mention only a few, there are garbage disposals, automatic dishwashers, room air conditioners, and, perhaps the worst offender in some homes, the stereo or hi-fi. Students are exposed to these noise sources at home and to others at school while working in some shops, i.e., woodworking, forging, printing and repairing auto and aircraft engines. Worst of all, however, students are exposed to intense noise levels during recreational activities in and out of school. These activities include participation as musicians or spectators in rock-and-roll "music", drag strip racing, sports shooting and many others.

Recent studies by members of our Bureau and by others have shown that during the 2- to 3-hour rock-and-roll sessions, musicians are exposed to noise levels of from 105 to 115 dBA, and the spectators are exposed to from about 100 to 110 dBA. I should point out that the American Conference of Governmental Industrial Hygienists (ACGIH) recommended in 1969 that the permissible noise exposure level for industrial workers is 90 dBA for 8 hours, 97 dBA for 3 hours, and 100 dBA for 2 hours.

These studies showed further that there is an increasing percentage of hearing loss for high frequency sounds among high school and college students, perhaps reflecting their exposure to high noise levels from music and other sources. This simply means that young people reporting for their first job already have a slight hearing loss that may become more severe upon prolonged exposure to industrial noise. These early losses will reduce the tolerance of young people for the prolonged types of occupational noise exposures they may encounter during their working lifetime.

These are just a few examples to illustrate the variety of potential health hazards which may be encountered in school shops. The important question is, what can we do to protect the health of our children? The answer to this question is no different from the approach used by occupational health personnel in their solutions to similar problems in modern industry.

First, school officials--principals, teachers, school physicians and nurses--must become aware of the potential hazards involved in various shop operations. To obtain this information, a survey must be made to determine what materials and physical agents are used in the shops, or may be produced by these operations. After this list is obtained, the next step is to determine which of these substances or agents may create harmful exposures. The third step is to learn the degree of exposure to students which includes control measures in use. This procedure is usually referred to as a preliminary survey by occupational health specialists.

If potentially hazardous exposures are suspected, they may be controlled or eliminated by one or a combination of the following general methods:

(1) Substitution of non-toxic or less toxic materials, e.g., use of a petroleum solvent in place of carbon tetrachloride as a cleaning agent.

(2) Isolation or enclosure of operations or machines, e.g., separation of electric arc or acetylene gas welding operations from the rest of the class area to protect other than operators from ultraviolet radiation, gases and fumes.

(3) Control of hazard at the source of generation, e.g., use of an auto tailpipe exhaust system to protect students from carbon monoxide; use of local exhaust ventilation (hoods) to remove gases, fumes and smoke produced by foundry furnaces and glazing kilns.

(4) Use of personal protective devices. The most familiar of these devices are respirators, goggles, face shields and clothing. It should be emphasized, however, that respirators should not be relied upon to protect the wearer from harmful exposures unless other control measures are impracticable. Respirators should be used only for intermittent or emergency purposes.

(5) Maintenance and housekeeping. Poorly-maintained equipment can be the source of harmful exposures. A good example is internal combustion engines, which, if not properly adjusted, generate higher concentrations of carbon monoxide and other gases than an engine in good running condition. Another example might be cited: In print shops, if the thermostatic controls on linotype machines and lead remelt pots are not properly maintained, high concentrations of lead fume will be created.

Good housekeeping and cleanliness are important factors in reducing or eliminating potential health hazards. Mercury spilled on laboratory benches or floors from broken thermometers, manometers or other devices should be cleaned up immediately.

(6) Personal hygiene. Cleanliness of the body is just as important in school shops as it is in the home. Frequent washing with warm soap and water (not solvents) is the most important method of reducing the incidence of dermatitis from contact of the skin with certain chemicals.

These briefly are a few examples illustrating methods used to control occupational health hazards. How are these methods implemented? First, whenever new shops are to be constructed, the control methods should be designed and included in the original plans. These plans should, of course, be reviewed by competent persons. Second, periodic surveys should be conducted in school shops to ascertain that adequate controls are in use. This should be done by a qualified physician or industrial hygienist. And third, periodic health examinations and laboratory tests, where indicated, should be given to those students exposed to hazardous chemicals or physical agents. School nurses can and should assist the physician with these examinations.

I made a survey in five schools about eight years ago, and results indicated that, in general, control measures had been installed in the various shops. Furthermore, many of the teachers were aware of the potential health hazards involved and instructed or cautioned the pupils accordingly. More effort should be directed toward this area because, just as in private industry, thousands of new chemicals are marketed each year as well as countless new electronic devices. These, as well as the old hazardous materials, should be investigated.

Though I have laid great stress on the need for environmental controls in the "industrialized" area of the school, I do not want to imply that these are the only areas requiring environmental controls. The engineering needed to avoid excessive heat or cold, to avoid glare and to provide a comfortable work place for teacher and pupil is every bit as important as the safety considerations I have already mentioned. Too frequently, relatively untried innovations are designed for buildings which must be used for many years to come without the preliminary experimental use of these innovations that would guarantee their ability to function properly.

This, then, is one industrial hygienist's viewpoint on managing a safe environment in schools. Others trained in this field may have stated the case quite differently. However, the points discussed here have been applied by many different types of industry for many years. If an honest effort is made by management to comply with existing standards or guidelines, and if the general methods of control discussed earlier are used, students and teachers and other school workers will be protected from possible impairment of health by the potential occupational health hazards inherent in the environment.

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Managing a safe environment in schools—the administrator's viewpoint

Morris J. Ruley

(Excerpts from Tulsa's guide, "An Accident Prevention Program for Industrial Arts, Vocational and Technical Education Programs".)

Accidents are undesirable, unplanned occurrences which can be prevented and which often result in bodily harm, loss of school time, property damage and even death. Thus it should be the policy of all school systems to take every reasonable precaution for the safety of the students, employees, visitors, patrons and all others having business with the schools. The schools believe that safety to everyone concerned with our schools is not only a protective measure during school hours, but also is an instructional means of developing an appropriate mode of behavior to minimize accidents at all times.

A major function of education is that of building desirable attitudes. One of the most important attitudes is an active concern for protection against bodily harm and for the conservation of human life. Accordingly, many experiences are provided for students at all age levels to see, to hear and to think in terms of safety, to the end that their reactions in life situations will be automatic and effective. Safety education is therefore a continuous process which contributes to the enrichment of many areas of learning.

Tulsa's publication, "An Accident Prevention Program for Industrial Arts, Vocational and Technical Education Programs in the Tulsa Public Schools", developed by a group of teachers in an in-service program in 1968-69, incorporates the safety policies and approved procedures that should be followed in the instructional program of these curriculum areas.

It includes techniques and instructional methods that have been developed over a period of years and found useful by personnel in the field.

The policies and procedures included are to be followed in all schools. They apply to the use of equipment in shops and laboratories in which machines, hand tools and materials applicable are used. All instructors and other school personnel in charge of activities within the categories listed are responsible for the observance and practice of the policies and procedures listed. A copy of the manual must be available to all school personnel of these subject areas.

One of the objectives of this phase of the instructional program is to prepare young people for safe living in a society which is becoming more mechanized and complex.

The purpose of the guide is to assist instructors and administrators in their efforts to prevent accidents and injuries in school shops and laboratories, through proper planning of the educational environment. The guide lists certain policies and procedures to be followed in organizing and administering a program of shop safety and suggests methods and techniques for implementing the recommendations.

The guide is a blueprint for safety; the continued interest, intelligence and educational skills of teachers and administrators are essential in applying the suggestions listed.

The first purpose of an accident prevention program in school shops and laboratories is immediate and urgent to prevent accidents to students or others, damage to equipment and facilities, or interruption of the educational processes. All programs of our schools must reflect concern for accident prevention.

Safety concepts and safe practices grow equally from an understanding of the points that contribute to accidents and from performing tasks in a safe situation. Such experiences and understandings will guide the actions of individuals throughout life, thus playing an important role in developing sound concepts and attitudes pertaining to occupational safety.

Teachers should study the materials in the guide and follow suggestions for coordinating a program of safety and accident prevention with the course of study being followed for a specific subject area.

The policies and suggestions correlated with activities and correct use of equipment in industrial arts, vocational and technical education facilities will:

help to plan a complete safety program
help students to work more safely
help students to become aware of safety practices that apply in and out of school
protect students from accidents
assure the best, easiest and safest way to do a job successfully.

Relating safe practices of the shop and laboratory to other daily activities of the student, both in and out of school, should be practiced. Safety should be emphasized in all phases of instruction. Those in these subject areas have one of the best opportunities of anyone in the schools to give real meaning to accident prevention. "THE SAFE WAY IS THE BEST WAY."

An inescapable responsibility of the school as an administrative agency is to provide and maintain a safe environment in which industrial arts and vocational-technical activities may be conducted in safety and under healthful conditions. In addition, the school has the added responsibility for safety education, a function directed primarily by the teacher, who can capitalize upon the creative environment of the shop or laboratory in providing opportunities for meaningful applications of safety practices. It is the teacher's responsibility, also, to supervise and enforce acceptable safety practices. All facets of an occupational program, including the physical plant, tools and equipment, eye safety and respiratory equipment, the instructional program and supervised activity, must contribute to the development of a safety consciousness or attitude to govern the daily habits of students in the shop or laboratory, and which will prevail in all activities of the school and beyond.

Fundamental requirements of a healthful and pleasant environment should be embodied in the physical plant. Adequate light, both natural and artificial, contributes to safe practices and good housekeeping. Satisfactory heat and ventilation, with special provision for dust control and elimination of obnoxious fumes, are prerequisites to a productive environment. Appropriate acoustical treatment of walls and ceiling, combined with proper colors on all visible surfaces, contributes to the overall effectiveness of the program. Floors require appropriate covering, and in some locations need special finishes to insure safe footing. Provisions for storage of supplies, assembled projects, partly-completed parts belonging to individual students, reserve supplies and equipment maintained by the instructor, as well as a combination storage and drying room, are essential components of the physical plant.

Tools and machines should embody appropriate safety features and should be of the finest quality. The plan of the shop and laboratory, particularly the arrangements of machines, should provide well-lighted work areas with appropriate safety zones.

A primary function of the teacher is to give formal instructions, and to direct the learning activities of students as these activities relate to the implementation of ideas involving the use of tools, machines and materials. It is the teacher's responsibility that safety be taught as an integral part of the instructional program, and that activities conducted under his supervision are performed in accordance with acceptable safety practices. Safety is not an imposed discipline to be added as a restrictive control of conduct, but is an integral part of all activity and is practiced to the degree that a safety attitude governs the habits of the individual.

Although time does not permit detailed suggestions, either for general safety precautions or for specific practices in respective areas, some of the essential components of a safety program are submitted in the hope they will aid the teacher in conducting a safety program as an integral part of the industrial arts and vocational-technical activity. A bibliography of safety material will assist in the study and preparation of appropriate instructional material. (The teacher is referred to a very comprehensive bibliography: Williams, William A., Editor. Accident Prevention Manual for Shop Teachers. Chicago: American Technical Society, 1963.) Essential components of a safety program may be itemized as follows:

(1) Accident prevention
(2) Developing a safety consciousness or attitude

(3) Developing safety practices in the school
(4) Planning the shop
(5) Selection of appropriate equipment
(6) Using personal equipment such as goggles, face shields and clothing
(7) Eliminating health hazards such as harmful chemical agents and excessive wood dust
(8) Teacher liability
(9) Evaluating the safety program
(10) Recording and reporting accidents.

Safety is everywhere. Some of the best opportunities for accident prevention in the entire school program are in industrial arts and vocational education. Motivation is generally high in these classes, for students enjoy them. They feel that these courses are relevant to their lives. They are eager to handle tools, equipment and materials and to see the result of their efforts. Shops and laboratories provide "doing" situations where theories must be practices, where there are outlets for the energies of active teen-agers. With obvious hazards involved, students can easily see the need for group cooperation. Together the motivating factors provide fertile ground for learning accident prevention.

Much safety education is indirect. When a teacher demonstrates cutting equipment and cleans the refuse away with a brush rather than with his bare hand, he is teaching safety by example. He is also teaching safety when he insists on an orderly, well-disciplined classroom.

Direct safety education can take several forms. It is often integrated with teaching specific skills. Many schools promote such integrated learning by including safety procedures in instruction sheets given to students. Accident prevention is also taught in time set aside specifically for this purpose.

Conditions in each school, and in each shop, laboratory and related classroom within the school, will call for different approaches. What is essential is that safety education becomes a systematic, carefully planned and continuous feature of the curriculum.

Study of general safety and safety education, shop and laboratory safety, and occupational health, gives added impetus to safety education by including specific units.

A study of desirable "Teacher Competencies in Trade and Industrial Education", Office of Education - Walsh, 1960, underlines the necessity for professionalism in safety. Out of 107 competencies, the one which respondents rated most important were:

(1) The ability to develop student attitudes toward safe practices and safety consciousness in job performance.

(2) The ability to stimulate and maintain interest throughout the instructional process.

(3) A knowledge or understanding of safe practices in teaching the operation of industrial equipment.

(4) The ability to develop appreciation of good workmanship.

Two of these most desirable competencies include safety explicitly; all four contribute to the prevention of accidents. These conclusions clearly indicate the great concern for safety among trade and industrial educators.

Goals worth planning for. The problem is clear enough: Accidents loom before us as a leading cause of disability and death, especially among young people. Accelerated economic, social and technological change will constantly pose new accident problems. The challenge to educators in school shops, laboratories, and related classrooms is equally clear: For the present--to promote the safety of students now in school; for the future--to prepare students for accident-free adult lives both at work and on their own.

What we need is people who act safely under all circumstances. This means people who perform routine operations in a safe way. It also means people who anticipate and overcome hazards in new and unfamiliar circumstances. Education to prepare such people includes four aspects: habits, skills, knowledge and attitudes.

How do we educate to change attitudes? Discussions of this problem can become exceedingly complex, but certain guidelines are clear:

(1) Attitudes are contagious. If administration, faculty and student leaders demonstrate genuine concern and enthusiasm for accident prevention, students are far more likely to follow their example than if they display indifference.

(2) Involvement promotes favorable attitudes. A great variety of learning experiences in which students actively participate are necessary.

(3) Positive approaches promote favorable attitudes. Emphasis should be on what is safe, rather than on what is not. The destruction caused by accidents has a place in safety education only if it is clearly used as the basis for positive action, rather

than to instill fear.

(4) Attitudes, like other learnings, are built upon the raw material with which the students arrive. Teachers must find out what the students already know and feel about risk and responsibility and build from there; otherwise students are likely to reject their efforts.

Safety education has a definite place in the school shop program. Its aim should be:

(1) To develop a safety consciousness among teachers and pupils.

(2) To create a desire to work and act in such a way so accidents will be reduced both in and out of school.

(3) To develop safe working and living habits in the school, in the home, in public and on the job.

(4) To reduce accidents in the school shop to a minimum.

A good safety program in the school shop is dependent mainly upon these factors:

(1) A safe environment in which to work.

(2) The use of safe activities within such an environment to form safe habits and practices.

(3) The attitude of teachers and students toward better safety in the school shop.

Organization of the shop is vital to shop safety and is important from the beginning of the period to the end of the period. It must be given careful consideration because of its relationship to accident potential. Each student should be aware of his function as a part of the class group and as a member of the shop organization.

Unless carefully planned and executed, safety activities can easily be "shots in the dark" or even detrimental in their impact. Thus both teachers and students should ask themselves: What goals were set? To what extent were these goals achieved?

Other questions which may help in evaluating the effectiveness of accident prevention efforts are:

What did the students learn?
What experiences did they have in safety?
What hazards did they control or overcome?
What initiative did they take?
Were accidents and near-accidents reduced?
Do students handle accidents and near-accidents more effectively?
Is there increased interest or any other change in attitudes?
Will classroom learning carry over into family and community living?
Will classroom learning carry over into future occupations?

Analysis of the answers to these questions is one form of evaluation. Performance tests, tests of safety knowledge, and attitude scales can also be used. Whatever the device, evaluation can help reinforce and extend learning. It can also reveal both strengths and weaknesses in safety instruction and serve as the basis for making good programs even better.

Many techniques for safety education in vocational courses, industrial arts, science, home economics and other practical arts have been developed. Yet we lack conclusive evidence that any one way is the correct way. For this reason, each school and each classroom can be a research center for accident prevention.

Managing a safe environment in school shops and laboratories is a very important responsibility of the administrator.

The following references, along with materials in use, were researched in the development of Tulsa's guide:

An Accident Prevention Program for School Shops and Laboratories
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Visual art for industry—implications for the industrial arts curriculum

Charles W. Becker

Today, to a greater extent than in any previous period in our industrial history, the importance and need for technical specialization have been projected vividly into our society. We have advanced from a society primarily characterized by occupation as agrarian, requiring little educational preparation, to an ultra-industrial society, scientific and technical in nature, requiring an infinite amount of specialization and consequently demanding an education providing a high degree of technical knowledge for its members.

As a result of the rise in scientific and technical endeavors by our nation, all areas of technical professions responding to the needs of specialization have experienced the creation, development and growth of technical skill areas that prior to this time were little used or unknown.

This has been especially true in the technical field of drafting. It has not been too many years ago that draftsmen could be categorically classified into two major fields, civil and mechanical. This was due to the fact that most phases of engineering which required draftsmen were in one of these two classifications. The diversification and growth of the engineering profession began shortly after the conclusion of the Second World War and were the direct result of several scientific and technical advances that had been developed and proven militarily successful. Additionally they revealed a potential that, if properly modified and applied, could benefit mankind in a constructive way. The most significant of these scientific advances were electronics, jet propulsion and nuclear power.

Research, design, development and application of these new sources of power necessitated specialization within the engineering profession. Therefore, as the new classifications of the engineering sciences began to emerge, the need for draftsmen to relate new engineering design concepts in graphic form became evident.

According to the Dictionary of Occupational Titles, there are over sixty classifications of draftsmen in which an estimated 300,000 draftsmen and designers are presently employed. In an attempt to group these many drafting areas into one general classification, the term Engineering Graphics has been frequently applied.

The role of the draftsman today has taken on new and important proportions with increased responsibilities. The engineer, prior to this time, had been largely responsible for the entire project development. However, it was found that the draftsman, if properly trained, could assume many of the responsibilities of the total design sequence and could release the engineer to devote more time to the development and application of engineering theories and concepts. In many instances, draftsmen have now assumed the role of support personnel, partners in design, rather than just providing a service of delineation.

In the last twenty-five years, a new profession related to and often classified as a form of engineering graphics has emerged and has been utilized with great success by industry. The field referred to is visual art.

Visual art is one of those professional areas difficult to bracket comfortably in any one discipline. It is in the broadest generic context a form of fine art, commercial or advertising art, industrial arts and graphic arts. It can only be termed as a phase of engineering graphics because of the service it provides to industry and because one of its basic foundations of preparation requires an exceptional drafting ability. On the other hand, the profession requires a superior art ability in various media. To say that it is more art than drafting or more drafting than art would be difficult to substantiate.

The utilization of visual art is now receiving the emphasis it so justly deserves. It is a method of communication that has withstood the test of dependability and accuracy for many centuries and, in many instances, without the aid of the written word.

Historically, visual illustration dates back to prehistoric civilizations. The cave dwellers of Lascaux, France and Altamira, Spain, graphically recorded on the walls of their caves those aspects of their environment that were most important to them.

As far back as 3,000 BC, ancient civilizations in Egypt, Asia Minor and India recognized the effectiveness of the pictorial form of communication. Writing, which was developed about this time, was formally a picture writing and structurally a word and syllabic writing. Actually, illustrations were the mass-media communication of that day.

Perhaps the oldest form of technical illustration used primarily for the construction of apparatus was mentioned by Marco Polo (1254-1324?) during his travels to the Far East. He found the Chinese had developed a system of planning utilizing perspective drawings.

During the Renaissance, two Italian artists used pictorial illustrations to make significant contributions to the technical and scientific knowledge of that era.

Leonardo da Vinci (1452-1519) used illustration extensively to record his extraordinary inventions. His hyperactive inventive abilities made it necessary to record a proliferation of ideas for future reference. To assure conciseness and accuracy, he illustrated his ideas and supplemented them with notes.

Michelangelo Buonarroti (1475-1564), artist and sculptor, developed a series of anatomical illustrations that were used by physicians of that period.

Today, the purpose of visual art is, as it was in its early beginnings, a means of communicating or promoting an idea or concept, easily understood by everyone. However, due to the complexity of our industrial society, we have expanded the capabilities of visual art to provide a complete system of reporting and instruction for industry.

Artwork required of artists engaged in the preparation of visual art can generally be classified into three categories. These are technical illustration, presentational art and graphic statistical presentations.

Of all the engineering graphics areas of specialization, none have achieved the degree of primacy or glamour that is now being enjoyed by technical illustration.

Technical illustration is the utilization of three-dimensional graphics to communicate and promote design concepts relating to function, relationship and the assembly of parts and products. Its ability to present intricate and exacting procedures to individuals with limited technical education has made it a valuable asset to industry.

Technical illustration as we know it today had its early beginning in England during the First World War. The use of illustrated manuals was found to be most effective in providing instruction for the repair and maintenance of military equipment. After the war the nation returned to normal, and the technique declined due to the lack of need for instruction of this type.

At the beginning of World War II, England was once again faced with the task of providing instruction to men with limited technical backgrounds. These workers were experiencing great difficulty in comprehending the written technical materials so vital to the war effort. Paradoxically, the armed forces had drained the manpower of Great Britain. Therefore, there were few men to train, so women who were totally without technical skills were enlisted to perform defense tasks. Through the utilization of pictorial sequential instruction, the most intricate weapons systems, radar, electronics and assembly processes were mastered.

The United States Department of the Army was requiring early army field manuals to be written on levels not to exceed the fifth-year reading ability. By using pictorial illustrations, the level of the written text was presented in more technical terms which were better accepted and understood by all levels of learning ability.

After the war, industry was faced with the task of rehabilitating and placing returning servicemen into civilian occupations. Technically-illustrated training presentations and manuals made the transition from army-oriented training to civilian tasks a smoother one.

Technical illustration requires an exceptionally-prepared draftsman. He must be well-grounded in technical and mechanical concepts, drafting fundamentals, design, have proficiency in various art media, and an understanding of the aesthetics of fine art. He must be able to develop layouts and produce finished illustrations for reproduction in reference books, brochures and technical manuals. He also prepares drawings from blueprints, designs, mock-ups and photoprints by methods and techniques suited to specific reproduction processes. He lays out and draws schematics, perspectives, orthographic or oblique angle views and shades or colors drawings to emphasize details or eliminate undesired backgrounds using one of the many art media.

The role of the technical illustrator as a member of the design team is one of close cooperation with planning processes in both initial and final phases. Engineers and scientists first develop design concepts which are subjected to many tests with results studied to determine the project's feasibility. It is at this point of planning that the illustrator is asked to develop prototypes of the idea. After this initial phase, the project is forwarded to the production planning section to plan the layout of machinery, movement of materials and determine the sequence of operations that will assure the efficient flow of the manufacturing process.

Then technical writers develop manuals and the necessary literature to describe the operation and maintenance of equipment. These are illustrated by the technical artist with drawings describing pictorially the total manufacturing process.

Within the field of technical illustration, a newly-developed professional area has had a great effect on the world. This is animated technical illustration or simulation.

Due to the preponderance of television exposure given the recent space exploits and especially the moon landings, the field of technical simulation has proven to be a most valuable intermediary between the highly technical aspects of space science and the general public. In the absence of visual contact or communication with the space craft, animated simulation of the routines and maneuvers performed in space were easily comprehended by millions of television viewers and provided credibility and assurance to an almost unbelievable scientific accomplishment.

Even the best design must be presented to and accepted by management before it can be implemented for production. In many instances, the success or failure of the project may depend upon its presentation.

The planning staff, confident that the function of the design is technically correct, must now convey the soundness of their idea to management, usually through a statistical presentation.

"Graphic statistical illustrations" refers to those presentations that provide a means to project trends, potential markets, production cost, sales, outcomes, evaluations or any other data relative to the function of the industry. They are a method of graphically expressing situations and attitudes of industry.

Artists engaged in the development of this type of visual art are generally referred to as industrial artists or graphic designers.

Preparation for this profession ideally includes drafting, lettering, color theories, reproduction processes and basic statistics. The artist is not required to provide statistics, only to record and present the data in the most understandable form. A basic comprehension of the figures he is asked to project will be most beneficial in decisions regarding prominence and sequence of the data. In presenting statistics proportion and emphasis are essential because they indicate the degree of related importance of the information.

Presentations may be in the form of flip charts, overhead projectuals, filmstrips or slides and are used to complement an oral report. Many types of charts and graphs may be utilized, the determinate being the method that presents the statistical information in the clearest, most concise manner.

Graphic statistical art and presentational art are often considered one and the same, the primary difference being the purpose of the presentation and to whom it is being directed. Statistical information is utilized by management for planning, while presentational art, often referred to as institutional art, is primarily concerned with providing information as a method of instruction within the company organization. It is usually used in departmental staff meetings to present courses of training, seminars, employee orientation and changes in company policies.

Probably the most beneficial training that the visual artist can acquire is through apprenticeship, in-service or on-the-job training programs within the company organization. This is often supplemented with part-time schooling.

Educational preparation for visual art is presently available through several types of institutions. Curricula offering these courses are found in vocational and technical high schools, technical institutes, junior colleges, correspondence schools, and a limited number of four-year colleges and universities. Offerings in the four-year institutions usually consist of one or two courses in the engineering graphics curriculum.

There is a need to develop new and expand existing courses emphasizing visual art on the college and university levels. Employees with four-year degrees are in a much more favorable position to be promoted within the company organization than those employees with two-year certification. Paradoxically the two-year programs concentrate heavily on the aspects of drafting that industry requires and, therefore, are better preparation for industry.

It was previously stated that it was difficult to categorize visual art specifically as a discipline within the fine arts or industrial arts curriculum. But if we are to institute new programs of visual art in the four-year college, who will be responsible for the development and implementation of the curriculum?

Ideally, the industrial arts curriculum would be best suited to undertake this responsibility, with strong cooperative support from the fine arts field.

Industrial arts provides an opportunity for the student to associate and apply technical and mechanical concepts that require a high degree of precision, both in planning and implementation. Additionally, the basic fundamental requirement of visual art is a broad but exceptional proficiency in engineering graphics which is solidly established in the industrial arts curriculum.

Included in industrial arts and most essential in visual presentation is graphic arts, which provides the artist with the principles of photography, typography and an opportunity to explore the advantages and limitations of various methods of reproduction. To provide an excellent foundation toward understanding technical processes, related courses that should be included are design, strength of materials, metal and foundry courses and plastics.

The fine arts curriculum should provide training in spatial design and relationships, sketching, color and rendering techniques, and familiarization with the aesthetics of fine art.

It should be noted that the underlying philosophy of industrial arts regarding the types of skills acquired and their application seems more compatible to visual art than does that of fine art.

Industrial arts is primarily concerned with providing a thorough understanding of the product--its design, materials and the processes necessary to produce one or mass produce as many as desired; while, on the other hand, fine art is interested in the perfection of media, techniques and color theories to create an original, one-of-a-kind object of art.

Not only will the industry-bound student benefit from visual art, but also the college student preparing to become an industrial arts teacher would benefit greatly from visual arts courses. By introducing technical illustration at the high school level, an interest could be created in a technical aspect of drafting that would generate a desire on the part of the student to participate in industrial arts.

Today high school students are more mature in their thinking. They know the importance of the industrial environment, and they are probing, inquiring and seeking technical knowledge. The present tendency is to dwell too long on the basic concepts of drafting, and this does not provide the student the opportunity to explore his capabilities. The evident result is boredom and, eventually, disenchantment with industrial arts.

Perhaps it is meant that visual art be content for the time being with its state of limbo between art and industrial arts, but it is attaining a degree of prominence and proven acceptability that will not permit it to remain unheeded for long. Perhaps now is the time for industrial arts to make its move.

In view of the requirement for specialization by industry, the total industrial arts program must now take a long concerted look at its curriculum content to determine if courses are adequately preparing students for entry into the industrial society. Industry has long contended that much of the training that is being presented to college students is not providing adequate preparation for the world of work.

Tradition seems to be our nemesis when we consider curriculum revision. By our very nature we tend to resist change or experimentation with course offerings and persist in retaining those aspects of training that have proven successful even though they have ceased to be relative to present-day requirements. There is a great need for introspective evaluation.

There are several approaches that should be considered to bring about a more compatible working relationship between education and industry:

(1) A closer cooperative effort between education and industry could help frame creative proposals for educational programs.

(2) Industrial arts must become more flexible and responsive in preparing students for the industrial environment.

(3) Provide a greater opportunity for students to specialize within the industrial arts curriculum.

(4) Encourage industrial arts teachers to accept summer employment in industry, preferably in the area of their teaching specialty.

In the past we have searched for sophisticated means to provide respectability and acceptability to our curricula. If we will make a genuine effort to improve the content of our curricula, acceptability and respectability will come in a natural way by their own merit.

Dr. Becker teaches engineering graphics at North Texas State University, Denton.

Superpositions of the art of technical illustration

Daniel B. England

When he heard an explanation of one of the objectives of this presentation, a fine arts instructor laughed. The objective which provoked laughter was the presentation of technical illustration as a close relative and in fact a part of the fine art activity of drawing and painting. Fine art related to technical "art"? How is this?

Actually, technical illustration superimposes itself substantially upon three fields of study. Like a great acetate overlay, it is a part of the picture of the engineering profession, of the business of marketing and of the fine art activity. Emphasis here will be on the third group: on a detailed analysis of the relationship of technical art to fine art.

A group leader charged with the responsibility of packaging the components of a radar system into the nose of an aircraft, sent a sketch of his plan to an illustrator with the order to make it into a finished drawing. The illustrator saw at once the engineer's sketch was already almost in the form of a finished drawing and at the most needed only to be traced. He was curious to meet the engineer who could draw that well, so he went to his area of work. On the desks of many of the men there he saw copies of this same sketch. Upon finding the artist-engineer, the illustrator asked him about his ability to draw.

The answer made two things very clear: good drawing is a necessity for visualizing certain kinds of problems and their solutions, and good drawing is a necessity to communicate them to others. Furthermore, this engineer's ability to draw had been the chief reason for his promotion to group leader.

In engineering, visualizing has its most extensive and everyday use in the "reading" of orthographic drawings. When such engineering drawings become complex, the ability to sketch them in three dimensions piece by piece is a great aid in their interpretation.

Another superposition of the art of technical illustration is atop marketing. One does not get far into the first grade of grade school before he knows the alphabet and can form the twenty-six letters into readable words on paper. Why is it then that some marketing men who are college graduates have called upon grade-school-graduate show-card writers to form words on paper? Well, it is because a particular paper might be an important one and that show card writer just might do a better job. It may be a flip chart for a sales pitch in Washington, DC, which could or could not get a contract amounting to millions of dollars.

Such flip charts require words and drawings. The marketeer knows how he wants them but he cannot create that certain professional businesslike look with his own hands. He must call in a man who is trained to letter and to draw. But even the called-in professional probably will not do it the way the marketeer wants it. Pity it is that he who must depend largely upon the charts for his success in selling cannot do the charts himself... the way he wants them. Also, in the immediate and unpredictable situations which occur in the act of selling, the salesman needs to draw on the spot. A course in technical illustration could give him that skill.

Some may doubt this. "Does it not take natural talent?" they will ask. Well now, this is one of the features of technical-type drawing. It may be done by rules and by instruments and by templates. So the adage "anyone can draw" becomes a truism and the person with no talent can draw the proverbial "straight line".

Engineering, then, and marketing are overlayed by technical art and projected as one concerted effort upon the screen of industry. Since long ago these have proven to be profitable partnerships. The third enterprise to be shown here superimposed by technical illustration is not an industry at all but an in-depth, cultural, noble human dimension, eternally lasting in its vistas of mind and soul enrichments--the art of drawing and painting.

And we will begin our examination of the ties between technical and fine art in the practical realm. The fine art graduate, to state it simply, needs more job opportunities. In the nature of the case only a few of these noble young people will find a place of service in teaching. Many will not find any place in their community where their talents are needed and appreciated and paid for.

This is not to say, as some will immediately infer, that the fine artist should prostitute his art for the sake of material gain. Neither is it to say that the fine artist should be shielded from the real world in an "ivory tower" in order to create immaculate art (which art, it seems, would be very limited insofar as its influence and benefit might be to a very human and very real world of living, breathing people who would be expected to appreciate it).

Let me write something personal at this point. During the years from 1937 to 1941, I learned by experience the wonders, the marvels, the fascinations, the tearful warm mysterious magnetic pull of the castle-filled land, or should I say sky, of the fine art of drawing and painting. If this description sounds a bit overdone, let me assure you I mean every adjective of it and can further claim that the same describes my feeling toward fine art today.

However, when I left art school, the particular art-castle which was my residence at that season was invaded. The invaders were hard, demanding, competitive people telling me either to live with them or else to get out of their way. Well, there could not be a reconciliation and at that moment that particular "art-air castle" dissolved and I found myself "homeless" on the plain practical earth.

Andrew Vincent of the University of Oregon Art School often speaks of the nobility of the work of the painter. It is noble. And it is natural for a fine artist to avoid if possible certain degrading influences. Such an influence is commercial art. However, and it is the major thrust of this paper, fine art school students should be shown the true make-up of technical art, because the inner nature of technical art makes it a very integral part of the finest kind of fine art. It should not be regarded as a degrading influence.

"Dressing up" template-type mechanical drawings to look "pretty" is not at all what is meant by relating them to the work of a fine artist. The name of their common denominator is space anatomy. Command of space is the draftsman's and the technical illustrator's special realm. Design of space is the fine artist's province. Yes, the artist designs in terms of objects, but he must also design the space around the objects, which normally should average about 70% of the total volume of the "created" area. In order to design space the artist should first be able to define space. Accurate definition of space measurements is a technical matter.

For this reason technical illustration, drafting and descriptive geometry can give structural strength to a painting. They can be as important to a painter as a course in anatomy. Anatomy for the structure of the body, geology for the structure of the earth, architecture for the structure of buildings, mechanics for the structure of machinery, and technical illustration for the structure of space.

Someone will say, "Oh, now you do not understand our art. We are not realists. We don't care about accurate pictures! We are painters of art values...."

The proposition of this paper does not point to realistic or even necessarily representative art. It is proposed, however, that a worth-while creative representation or abstraction must have for its inspiration the true natural structure of any subject. No, it is not to copy, it is to begin at truth, and having begun there, to go on to a convincing and authoritative original interpretation.

Just as he needs anatomy, botany, geology, architecture and mechanics, the artist very dramatically needs technical illustration, drafting and descriptive geometry. He needs to know space anatomy. But what is space anatomy? How does it help the artist?

The laws of harmony cannot be controlled if the artist cannot locate dimensionally to the eye the objects he paints. That is, locate one object in known relation to another, and all in identifiable relation to the flat surface of the painting, to the border or edge of the painting, and to the real world.

Sculptors regard their art performance in space to have a great advantage over the painter who they say must "struggle" with a flat surface which seems to them to be a great handicap to space design. But drawing the illusion of space is not a handicap. It is the painter's distinctive strength.

Painters look at it in another way: the flat surface is a picture plane which is a known base for the building of known, measurable (in terms of design) relationships of lines, planes, solids and space. The picture plane is like a vertical stage on which the graceful movements of ballet dancers define angles, parallels, perpendiculars and circle arcs. These are designed in their relation to the flat plane of the painting surface (the picture plane) and in relation to each other according to laws of design such as repetition, opposition, radiation, spiralation, involutation and gradation.

The elements of design and their workings together can be plotted by the artist--up to a point. After that their interlacing patterns of harmony are so complex no man can trace them. In fact a reliable measure of an artist's greatness is how far he can organize beyond the point he can analyze. This requires an uncanny ability, a gift from God. All the elements in a painting must be unified into one harmonious whole if the total painting is to have the impact of the oneness of living art. A flat pattern painting has its challenges to the artist, but a finished design in space is a far greater challenge, and the space anatomy lessons to be found in the study of technical illustration are suited to meet that challenge.

To say a pointing "works" is to say its elements are in harmony. If the elements are in harmony it is a harmonious arrangement in space. The fine artist knows where they ought to be. The technical illustrator knows the mechanics of how to get them there. For this reason it can be said that technical illustration is a great discipline for the fine artist--a discipline like anatomy, geology, biology, architecture and mechanics. It is like these but more necessary to painting than these, because technical illustration involves the total fabric of the total area of the subject represented.

Also, for the same reason, the fine artist ought not to despise technical illustration as a means to make a living. He would make an excellent illustrator. More than the average illustrator, the fine artist can appreciate the inherent beauty of his technical drawings and make them "work" to their maximum. In turn, knowledge and practice of technical illustration will greatly increase the artist's capacity to build powerful structure into his fine art paintings. The two are related--not on the surface, but in the inner structure from which the outer beauty of a fine painting must come.

Some specifics will illustrate what is meant by this relationship between technical illustration and fine art.

The isometric axes. All three are equally spaced 120° apart on the picture plane. Also, all three are foreshortened at the same 35°16' rate away from the picture plane and into the third dimension. These equalities have well-known advantages of speed of drawing and of uniformity of drawing. It has lesser-known values in composition for aesthetic reasons. But the fine artist will recognize their contribution of balance, repetition and parallelism.

The isometric planes. All three planes of a cube seen in isometric have the same 55° 16' tilt away from the picture plane. Receding planes of the same tilt can organize the space created by the artist on the flat picture plane.

The ellipse. The angle of tilt of a circle away from the picture plane can be judged by the eye by the width (minor diameter) of its elliptical shape. Because the ellipse is known by the mind to be a tilted circle, the degree of the angle of tilt can be correctly judged. This then becomes a means to measure the space patterns of a painting.

Other geometric shapes. The same opportunity to define space occurs with the square, the equilateral triangle, the pentagon, hexagon and octagon. Since these are regular in their actual picture plane shape (parallel to the eye) their angle of tilt can be judged by the amount of foreshortening shown.

The horizontal line. The nature of man is to maintain balance in a world held together by gravity. This makes respect of the perfectly horizontal line a must in a painting. Horizontals are a studied element in technical drawing. Have you ever seen a painting hung at an angle? Or have you seen more than a few on other than a regularly-shaped canvas? And if it was irregular, was it not horizontally-oriented?

The vertical line. The horizontal line naturally involves the vertical line, and this perpendicular relationship gives rise to an aesthetic response. Our sense of balance is involved. And the perpendicular is a subtle organizer of space. Depending upon its tilt, it can appear in the degree of any angle from 90° to 180°.

15°, 30°, 45°, 60° and 75° angles. These are recognizable divisions of the 90° angles of perpendicular lines. In a foreshortened position they are not recognizable to the eye. They belong to the surface (picture plane) only and become a chief instrument for what will be described later as reciprocal action. These angles must receive high regard in the structure of a fine painting. They are aesthetically important because our aesthetic responses are conditioned by our environment. If we mitre the corner of the moulding around a wall it is going to be at 45°. If we mitre our picture frame it will be at 45°. If we choose an odd angle, say for a shirt design, it will likely fall at some 15° increment of a perpendicular, 15°, 30°, 45°, 60° or 75°.

The technical illustrator turns repeatedly to these angles. They are indexed on the drafting machine. They are on his two triangles--the 30°-60° and the 45° triangle. Is this not a mechanical reinforcement of his ability to judge design on a natural basis?

Parallels. The drafting machine automatically makes precision parallel lines on the engineering drawing. Parallels are among the chief provokers of aesthetic response.

Also their spacing, representing equal distances into space, can define the design measurement of that space.

Line weight. In 90% of their work, the illustrator and draftsman are limited to lines--that is, no shading in solid grays or color. This forces them to use lines to their maximum capability in defining space, certainly a great lesson for the fine artist if he learns it well.

Orthographic principal views. Because of the nature of the manufacturing processes of building materials and the nature of the structure of equipment and machinery, drafting drawings are mostly geometric. And the regular shapes of the geometric figures appear in their true form when drawn in the principal views. These principal views show the geometric shapes parallel to the picture plane. Even further, in the complex projections of descriptive geometry, the reference planes are always drawn at 90° to each other and seen parallel to the picture plane, and measurements are taken from them into space. One purpose of descriptive geometry is to place lines and planes in their true length and shape positions parallel to the picture plane.

Manufactured articles. These tend to be symmetrical: therefore drawings of them are characterized by symmetry. God in His creation observes symmetry. He has made it a chief stimulator of aesthetic response. We ourselves are symmetrical--or are supposed to be. Any deviation between the features on one side of our body and those on the other is considered a defect. It's true with a car. Both sides had better be the same, or else it needs to be fixed. The appreciation of symmetry is as much a part of our nature as balance. Certainly painters must organize their paintings in consideration of it. The same skillful handling of symmetry as well as of other laws of design is needed in designing and illustrating machined parts.

Exploded views. Repeated parts and mating surfaces of parts are clearly shown in exploded view drawings of machinery. They are obviously beautiful, especially when shown on an isometric axis. Repetition is a chief ingredient also of the fine art product where its beauty is demonstrated, though in a more subtle way.

Arcs and lines. In technical art as in fine art the design element of opposition is working: line against arc, arc turned against arc, square over circles, line turned against line, etc.

Spokes. Spokes add up to beauty because of our aesthetic response to the beauty law of radiation. Experience in the geometry of the design of manufactured parts with fractions of circles ought to strengthen the fine artist's vocabulary in the possibilities of beauty by radiation.

The picture plane and reciprocal action. Now this picture plane which we have shown to be a base from which measurements of design importance can be taken is important also for another reason. It has already been compared to a vertical stage upon which harmonious patterns of lines and solids are designed in positions like those of ballet dancers. But it is more than a base or stage for patterns: it is also a base or a stage for movement.

The picture plane is a backboard for reciprocal action, back and forth, into the illusion of space created by the drawing and back again to the surface geometric shapes on the picture plane. For example, an equilateral triangle may enclose the limits of several objects represented in depth in the painting. The objects painted there create the illusion of space depth, but the regular geometric shape, the equilateral triangle, which encloses them belongs to the picture plane and so snaps the eye back to the surface. Back and forth. It creates movement in the painting, and movement makes for life. And a painting which has life has the very central heart element which makes the difference between ordinary art and great art.

In Part II of this presentation a series of transparencies will be shown to demonstrate the selfsameness of design laws in technical illustration and in the fine art of drawing and painting.

The transparencies will add convincing support to the objectives of Part I: 1) To review and to suggest expansion of the present involvement (superposition) of the art of technical illustration in the professions of engineering and in the business of marketing; 2) To give a new look to technical illustration by showing its place (superposition) in the art of drawing and painting; and 3) to make sense out of the proposition here presented to the fine arts student: why not consider technical illustration as a course of study in the fine art curriculum and why not consider it also as a way to make a living?

Because of his knowledge of fine arts, the artist would have reason to excel as an illustrator. At the same time his everyday work would contribute to the improvement of his fine art paintings. The practice of commercial art, because of its use of production techniques for surface effects, will degrade the fine art of the artist, but technical illustration is not a matter of technique but of bona fide structural, natural truths of God's creation--a very real and worthy subject for the greatest of artists.

Mr. England is on the faculty at El Centro College of the Dallas County Junior College District, El Centro, California.

graphic arts

Graphic arts career information

William Flack

(Because of extensive use of visuals, the talk has been summarized.)

The three most recent developments in career information that Eastman Kodak has developed in the form of audio-visuals are:

A series of 17 x 22-in. posters covering the areas of Graphic Arts Research, Graphic Arts Camera Man, Industrial Photography and Commercial Photography.

Two career presentations, consisting of 80 slides, 8-minute tapes, and a student follow-up brochure, have been developed with "Photography is . . . "emphasizing the photography careers, both professional and commercial.

The second presentation, "Ideas Won't Keep", explores the career opportunities in graphic arts as a visual communication technology.

Mr. Flack is Educational Specialist, Eastman Kodak Company, Rochester, NY.

3M's new curriculum material for the graphic arts

W. D. Baker

In order for you to understand why graphic arts personnel at 3M feel there is a need for new curriculum materials, I am going to discuss the following questions first:

(1) Should university-level graphic arts programs be teacher-oriented, industry-oriented, or both?

(2) What is 3M's prediction as to employment opportunities for teachers of the graphic arts in secondary schools and higher institutions of learning?

(3) What changes does 3M wish to see in graphic arts education on the college level in the 1970's?

It is our general belief that university instruction should not be completely teacher-oriented or industry oriented, but proficient in both areas. Thus one would have to set up a curriculum of teacher-oriented subjects and a curriculum for industry-oriented subjects.

Leaders in the graphic arts industry want to see new talent, able to think for themselves, enter into their profession. They wish professional, quantitatively-trained men. There is a great need for men with management and administrative ability, artists who can define esthetic values, scientists with research capabilities, engineers with mechanical aptitudes, economists to analyze trends in the industry, accountants to keep records of printing firms, excellent instructors to teach the youth satisfactorily, etc.

The graphic arts industry seems to be short of qualified graphic arts instructors, and this situation must be changed. Good graphic arts instructors are the key to inspire young people into the industry. These instructors must not teach the past methods of printing, but think to the future.

The graphic arts industry has always looked favorably on programs which permit the students to spend six months on the job training and then to go back to school for the academics for six months. Cooperative programs serve two functions. First, they give the student a better insight into the industry; and, secondly, the graphic arts firms fill their needs with new talent.

We see excellent opportunities for graphic arts teachers at the secondary, vocational and college levels. We base this statement on the statistics we are gathering from state vocational directors. Some forty states have reported that there are 700 schools teaching graphic communications. These do not include printing schools in three of our more largely populated states: California, New York and Illinois. In addition, there are approximately 168 institutions of higher learning teaching graphic communications. Also we know that the printing industry is growing at a rate of 7.9% per annum, and it is the seventh largest industry in the US.

The above information should convince any talented instructor to consider teaching subjects in graphic communications. Good graphic arts teachers will always be in demand. Today's world could not exist without printing.

Question three is a difficult one to answer unless we analyze not only your school's curriculum, but also the curricula of many other institutions of higher learning. This can be a tremendous task, but necessary steps should be taken. As a start, we would like to see an advisory committee for graphic arts curricula be set up, consisting of graphic arts leaders from industries, graphic arts leaders from the education field, from state and Federal governments, from graphic arts associations (such as Graphic Arts Technical Foundation, Printing Industries of America, National Association of Litho Clubs, In-Plant Management Association), the education directors of trade unions, etc. Also, these meetings would improve the communication among the different segments of the industry.

Personnel in the graphic arts industry see a great deal of growth during this decade in web offset, computer typesetting, electric scanning, plateroom automation and process color work. At the 3M Company, we are concentrating our research in four areas: the art department, the camera room, the platemaking department and the pressroom.

We believe tomorrow's artist is going to use more new tools designed to help him be more creative. The artist will spend less time tracing originals or laboriously producing intricate patterns by hand. He will have to learn that there are no limits to his creative talents. He will also have to learn how to wed the brush and the crayon with the camera, exposure unit and photographic materials.

The camerman under tremendous handicaps has produced beautiful black-and-white and color work. His tools have been a roll- or sheet-fed camera, a random choice of lighting, some mathematical formulas, plus his own know-how and genius. Tomorrow's camera will be programmed via computer. Lens settings, light intensity and time intervals will all be worked out in advance of the actual picture-taking. The development of the film will be automatic, either by chemicals or by heat, and the operator will be able to check his results while the copy remains on the copy board. This means that the cameraman will have to have better knowledge of electronics, be familiar with computer techniques and be able to use the scanner.

The plateroom, as we know it today, will be a thing of the past. Added power tools for the platemaker will be exposure units which will require no vacuum and motor-driven developing machines with rinsing and gumming units. Photoengraving will be produced in full-page size from computer-generated negatives or positives, and duplicated relief plates will be made at the rate of two per minute using photo-sensitive polymer-base materials. Thus the platemaker will have to have a better knowledge of electronics, be familiar with computer techniques and have mechanical aptitudes when using power assistance.

Tomorrow's pressroom will be equipped with presses which will be simpler to operate, but which will run at a much faster speed. Both letterpresses and litho presses will be equipped with thin, lightweight plates. Web fed letterpress and offset will dominate the next ten years. Most sheet fed equipment will be confined to the 30- and 38-inch sizes in commercial printing. Short runs on web presses will be a matter of course. Inks will be dried chemically or via electronic devices.

We know that at the 3M Company we have a great deal of technology that has not been put down on paper--technology that can be passed on to the instructor and then to the students who will help our society. At the present time, we are writing courses in graphic communications, and we want to be able to present educational institutions with courses in photography, proofing and design platemaking, etc.

What are the purposes of these courses?

(1) To provide exposure for 3M Brand Products and technology among apprentices and students.

(2) To supply teachers and trainers with up-to-date materials for use in the schools and print shops.

(3) To leave the correct impression that the 3M Company is a qualified supplier of industrial materials and is concerned with effective education and in-service training.

The platemaking course will be our first course available and will become a reality in the very near future. The contents are as follows:

(1) Instructor's script
(2) Overhead projection transparencies
(3) 3M graphic arts text literature
(4) Student exercises

(5) Planned demonstrations
(6) Supplementary materials
    a. Offset plates
    b. Chemicals
    c. Developing pads

Many people have discussed graphic arts education as a big lake in which to fish. We know there is a great need to better the communication channels between personnel in the graphic arts industry and in graphic arts education. If we all work together, we will all be successful at the fishing pond.

Mr. Baker is Educational Representative, Printing Products Division, 3M Company, St. Paul, Minnesota.

New audio-visual techniques, equipment and procedures for teaching and learning

F. R. Brail

More and more we are looking toward individualized instruction to meet individual needs. New media can help in the attainment of this and other educational goals.

The following are some of the advantages and strengths of the new media:

(1) Illustrate relationships of subject matter to student interests and needs.

(2) Enable learning to become meaningful to students having a wide range of abilities.

(3) Furnish the rich experience from which students can develop meaningful concepts.

(4) Provide orderly progress and clarity of development which encourages the student to form structures and establish meaningful systems of ideas.

(5) Bring freshness and variety to the student while learning.

(6) Establish a common background of experience and information.

As a general summary to the use of the various media, the following rules were presented for media users:

It is important that we make sure that students know what they are expected to learn and why it is important.

Distractions must be eliminated.

Encourage mental practice.

Stop often to emphasize key points.

Discuss principles and applications.

Continually test the student's performance.

Provide students with feedback opportunities.

Mr. Brail is associated with Western Michigan University, Kalamazoo.

Educational media: ideas for effective utilization

Alvin E. Rudisill

Introduction. This paper describes and illustrates methods of organizing audio-visual equipment to insure full and effective utilization of all types of modern instructional media for large group instruction, small group instruction and individualized study.

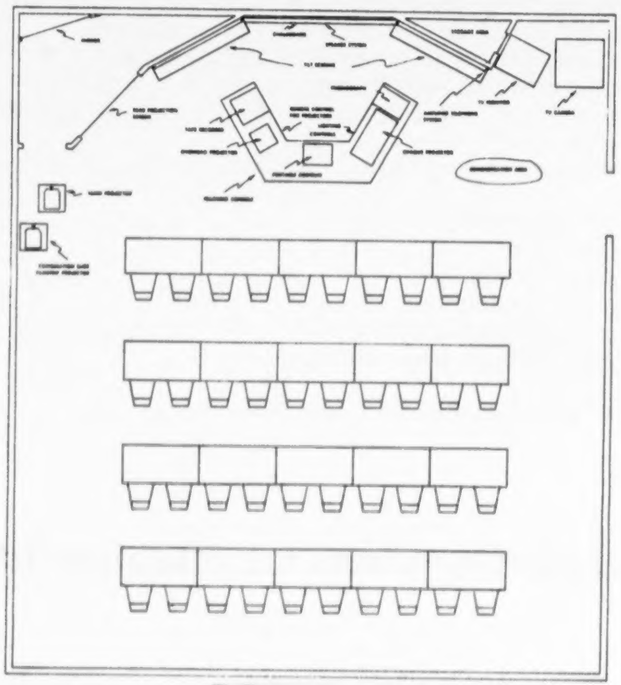
The semi-automated audio-visual classroom and the small group and individualized study laboratory are the result of two years of concerted effort by the staff and students in the Department of Industrial Arts at the University of North Dakota to improve instruction. Emphasis was on the development of facilities which would encourage greater use of modern instructional media by teachers and students at all levels of education.

It appeared obvious at the start of the project that shortage of equipment was not the major problem in most school systems, because supply rooms and office areas generally held a large inventory of dust-laden audio-visual equipment. Past difficulty seemed to stem from an attempt to provide too much flexibility at the expense of ease of utilization. The time and effort required for individual teachers to check out and set up equipment in most systems prevented them from incorporating audio-visual media into their instruction.

Recent trends toward modular scheduling and team teaching will enable administrators to schedule teachers into well-equipped audio-visual classrooms during large group sessions. In these classrooms, teachers can utilize any audio-visual instructional media without excessive pre-class preparation. These well-equipped classrooms will encourage greater use of instructional media, which, research has proven, will increase permanent learning.

The semi-automated audio-visual classroom and small group and individual study laboratory were developed on a limited budget. The materials (not including audio-visual equipment) for the construction of the portable equipment carts, portable rear screen unit, individual study booths, teaching console and remodeling of the front wall of the classroom cost less than one thousand dollars, well within the financial capability of even the smallest school system.

Large group instruction. The lecture method of teaching will undoubtedly continue to be the primary technique utilized when presenting organized material to large groups of students. However, recent studies have shown the need to supplement the traditional "telling" technique with visual materials to increase permanent learning. The semi-automated audio-visual classroom is one example of how efficient organization of the "tools for teaching" will allow teachers to improve lecture techniques and insure greater retention of learning by students. The "heart" of the classroom is the teacher's console, which contains an opaque projector, overhead projector, tape recorder, record player, light controls, FM receiver, amplifier and remote controls for operation of film, filmstrip and slide projectors which are viewed on a rear projection screen located at the front right of the room. The overall layout of the classroom is shown in figure 1.



SEMI-AUTOMATED AUDIO-VISUAL CLASSROOM

Figure 1

The classroom illustrated allows teachers to utilize the following instructional materials and techniques with little pre-class organization of equipment:

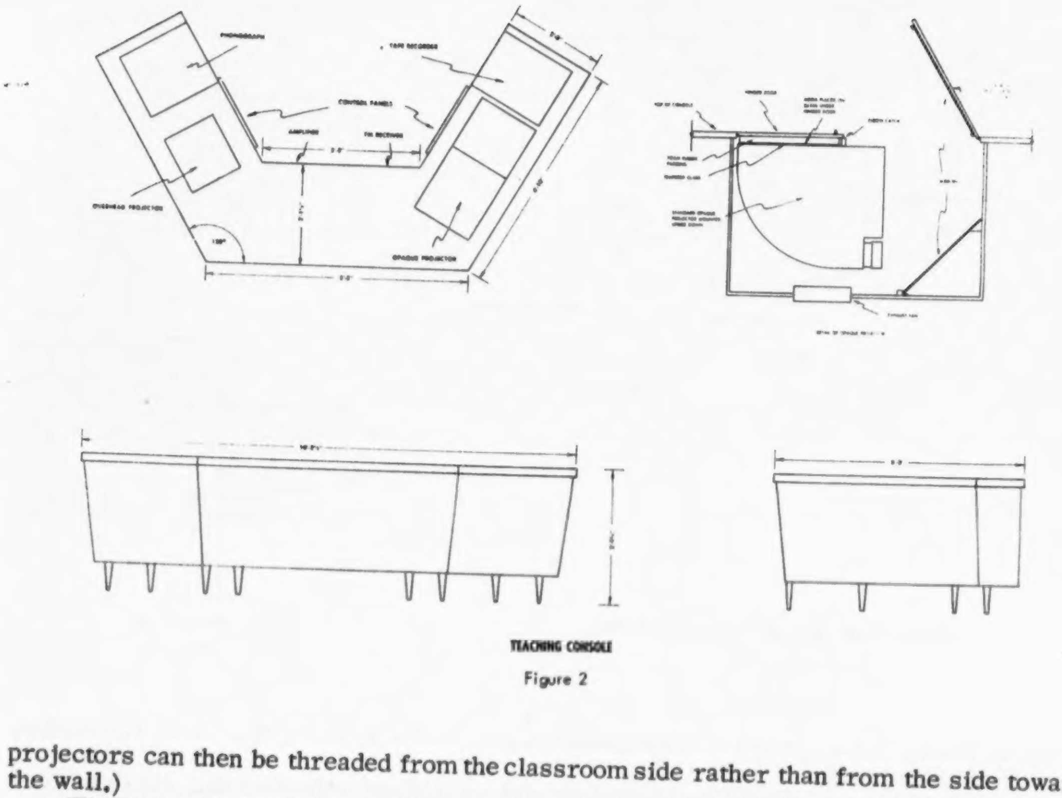
(A) Opaque materials, such as illustrations in textbooks or mounted pictures, may be projected with the opaque projector located directly to the left of the instructor. A permanently-mounted tilt screen is utilized for the opaque projector to eliminate keystoning. The opaque projector may be mounted on top of the console, or adapted to fit into the console as shown in the detail drawing in figure 2.

(B) Transparencies may be projected with the overhead projector (located to the right of the instructor in the console) to a second permanently-mounted tilt-screen on the front wall of the classroom. The overhead projector is mounted flush with the top of the console and the on-off switch is located on the right control panel on the inside of the console.

(C) Audio records and tapes may be played through the speaker system located above the chalkboard. The tape deck is mounted in the right wing of the console, while the record player is located in the left wing of the console.

(D) 16mm films, filmstrips and slides are projected on a rear projection screen located at the front right of the room. Remote controls for these projectors are located on the right control panel on the console and projectors can be started, stopped, reversed and focused directly from the console. Remote controls may be unplugged so that equipment can used in other areas.

(Note: the suggested classroom layout in figure 1 shows the projectors located at the left side of the room rather than the right. This is more desirable because the



TEACHING CONSOLE

Figure 2

projectors can then be threaded from the classroom side rather than from the side toward the wall.)

(E) Exploded detail monitoring of demonstrations is accomplished through a closed circuit television system within the classroom. Time-consuming demonstrations may be video-taped so that students may view the entire sequence during one lecture period.

(F) Remote demonstrations are possible by moving the closed circuit TV camera to adjoining laboratories while students view the monitor in the classroom. Audio is transmitted to the classroom from any place within the building by means of a miniature FM transmitter carried in the instructor's shirt pocket and a microphone pickup attached to his tie. This transmitter with the matched FM receiver in the console eliminates the troublesome cables and allows the instructor complete freedom of movement.

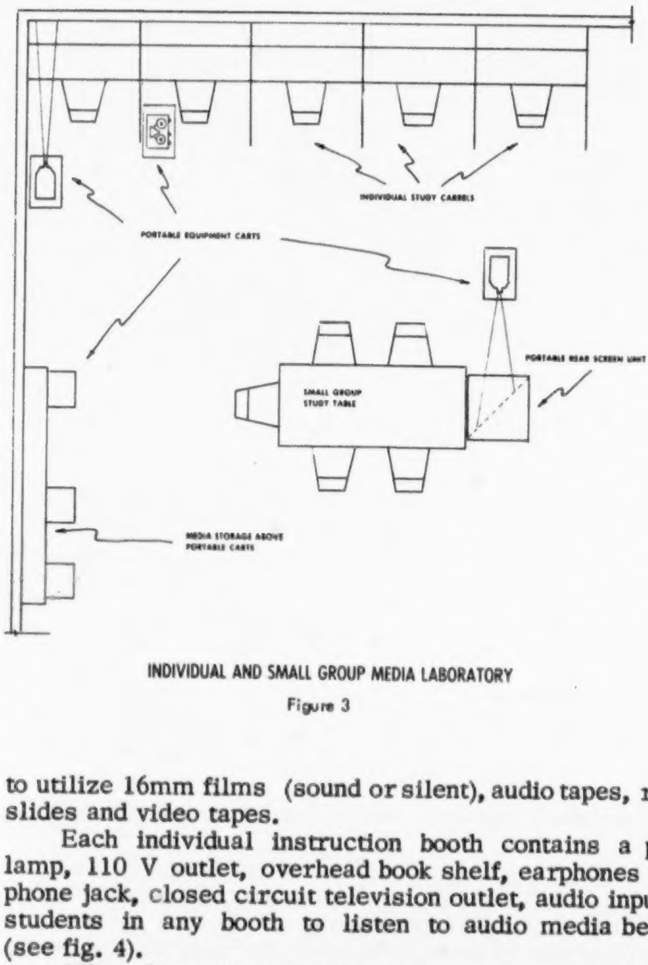
(G) Commercial radio and television are also available within the classroom. Commercial radio is piped into the classroom through the intercom system, while commercial television is available via an amplified antenna system.

(H) Supplementary lectures or discussion may be held via an amplified telephone system located at the front left of the classroom. A commercial amplified telephone system can be installed, or an extension phone with a magnetic phone pickup attached also works extremely well. The magnetic phone pickup is plugged into the amplifier located in the console so that all students in the room can hear the telephone conversation.

Classrooms such as the one illustrated should not be permanently assigned to individual teachers, but should be made available on a rotational basis for one or more periods per week in each class. If five teachers wished to utilize this classroom one period per week in each of their classes, it could be scheduled with little or no conflict. The availability of equipment for utilizing a variety of instructional materials will encourage teachers to develop resource libraries of pictures, slides, transparencies, filmstrips and films.

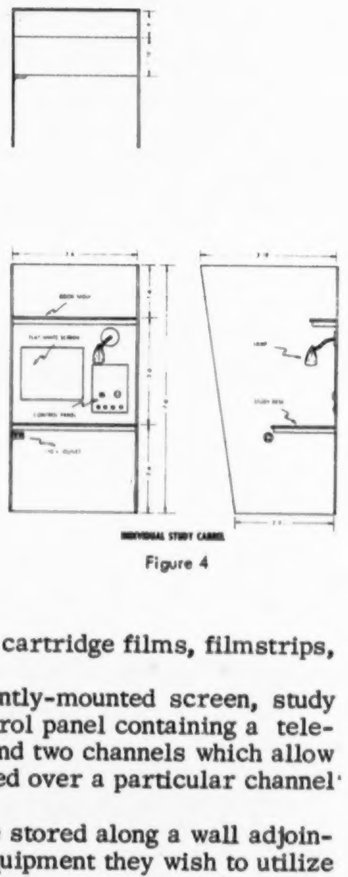
Individual and small group media laboratory. With the trend toward teaching of multiple classes, team teaching, small group centered activities, individualized instruction, flexible scheduling and nongrading of classes, it becomes imperative that provision be made for small group and individual viewing of instructional media.

These facilities should be organized so that commercial media programs as well as programs prepared by local teachers can be viewed. The individual and small group study laboratory layout shown in figure 3 enables individuals or small groups of students



INDIVIDUAL AND SMALL GROUP MEDIA LABORATORY

Figure 3



INDIVIDUAL STUDY CARREL

Figure 4

to utilize 16mm films (sound or silent), audio tapes, records, cartridge films, filmstrips, slides and video tapes.

Each individual instruction booth contains a permanently-mounted screen, study lamp, 110 V outlet, overhead book shelf, earphones and control panel containing a telephone jack, closed circuit television outlet, audio input jack and two channels which allow students in any booth to listen to audio media being played over a particular channel (see fig. 4).

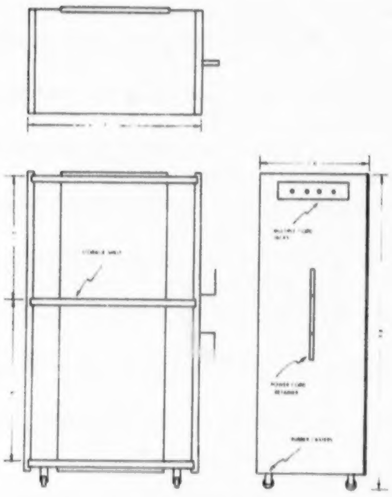
All media equipment is located on portable carts which are stored along a wall adjoining the booths. Individual students may wheel the particular equipment they wish to utilize up to any booth and view media on an individual basis. Earphones are used tb prevent outside distraction and to enable several audio programs to be run at the same time. Multiple audio jacks were placed along the back of each cart so up to three additional students may listen to media. The room need not be darkened since the projectors are very close to the screen and the lamp intensity is very bright. A working drawing of the portable equipment carts is shown in figure 5.

Equipment utilized in study laboratories such as the one illustrated should be simple to operate with very few elaborate accessories. Whenever possible self-threading, rather than manual-threading, machines and cartridge film and tape equipment should be purchased. However, manually-threaded equipment has not constituted a major problem even in the lower primary grades.

Small group viewing is accomplished through the use of a portable rear screen (see fig. 6) which may be used in a semi-lighted room. The media laboratory shown in figure 1 contains only one small group viewing area, so a speaker was used for the audio. However, if multiple small groups must utilize the media laboratory concurrently, earphones should be provided on each viewing table.

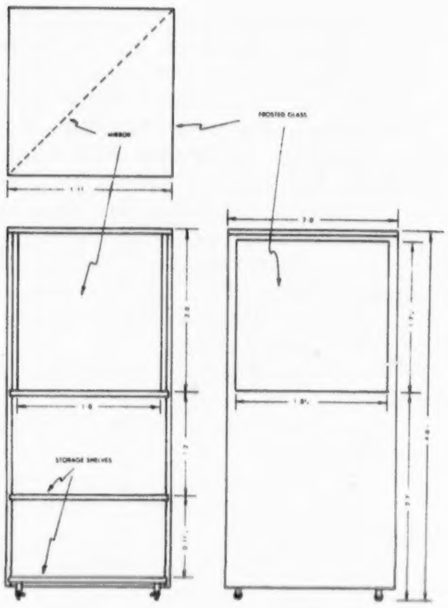
The following types of media equipment should be considered for utilization by faculty and students in the small group and individual study laboratory:

(1) 16mm film projector (automatic threading with earphone jack)
(2) 8mm film projector (magnetic sound-silent)
(3) filmstrip projector and/or viewer
(4) slide projector and/or viewer
(5) 8mm cartridge projector
(6) cartridge tape recorder (with earphone jack)
(7) manually-threading tape recorder (with earphone jack)



PORTABLE EQUIPMENT CARTS

Figure 5



PORTABLE REAR SCREEN UNIT

Figure 6

(8) 3-speed phonograph (with earphone jack)
(9) portable extension telephone
(10) small portable TV set (with earphone jack)
(11) equipment for video-taping

The media laboratory can also serve as the equipment storage center for a small school system since the equipment is located on portable carts and movement to other areas is relatively easy. If groups in other areas are not too large the portable rear screen unit can also be utilized.

Locally-prepared instructional media. Even though a great deal of commercially-prepared materials are now on the market, local teachers will need to prepare some supplementary media. Some of the possibilities for locally-prepared audio-visual instructional programs include:

8mm magnetic sound film. Teachers can utilize an 8mm film camera to prepare visual coverage of laboratory demonstrations or related instructional material. The exposed film is then sent in to be developed, and a magnetic audio sound track is added to the edge of the film. The projector also serves as a magnetic tape recorder, and sound can be added as the film is previewed. If any errors occur or changes are required, the magnetic tape may be corrected by simply recording over the original audio.

8mm cartridge film. This type of medium has become increasingly popular over the last few years. The only serious limitations have been the 4-minute time limit and absence of audio. However, cartridge projectors are now available which are correlated with cartridge audio tape recorders. This enables the teacher to add sound and also increases the viewing time of the 8mm cartridge film to approximately 20 minutes. This is done by recording inaudible signals on the cartridge tape, which automatically stop the 8mm cartridge film on a single frame and then start it again with another signal.

35mm slides - audio tape. Slide and tape presentations are undoubtedly the most easily prepared of all combination audio-visual programs. In addition to being simple to prepare, they are the most flexible as far as ease in making revisions or corrections. The slide sequences should be placed in carousels or slide trays for ease of viewing and storage.

Filmstrip - audio tape. It is now possible to convert a slide sequence into a filmstrip at moderate cost. The filmstrip has several advantages over the slide sequence as far as student utilization is concerned. However, the flexibility of making revisions or additions has been lost.

Video-tape. This new medium has many unique advantages, but, because of the high cost of equipment and supplies necessary to develop a series of programs, schools should first experiment with other types of proven media. At the present time very few commercially-prepared video-tapes are available, and consequently teachers would have to develop entire programs. The big advantage of video-tape over 8mm film is the immediate play-back feature.

Instructional media preparation center. A media preparation center should be provided where teachers and students have access to equipment, materials and storage for preparing instructional materials.

Student assistants should be utilized for preparation of instructional materials as well as for minor maintenance of equipment and facilities.

Specific equipment and materials required will depend on the type of equipment utilized for lectures and small group and individual study programs.

Planning facilities for ease of utilization. The following procedural steps should be considered when planning facilities for instructional media utilization:

(1) organization of faculty planning committee to determine types of instructional media to be used for large group presentations, small group study and individualized study.

(2) identification and evaluation of instructional communications equipment available for educational media.

(3) pre-planning for remodeling of existing facilities or new facilities to accommodate necessary "tools for teaching".

(4) conferences with electrician and carpenter or architect to plan construction requirements.

(5) construction of necessary furniture and cabinets.

(6) organization of media preparation staff (may be students) to assist with preparation of materials.

(7) continuous in-service education programs designed to acquaint teachers with new media and new instructional communications equipment.

The key to any good educational program is well-prepared, enthusiastic and dedicated teachers. Every effort should be made to provide adequate facilities, equipment and materials to assist them with the task of providing people of all ages with the knowledge and skills necessary to meet the challenges of tomorrow.

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plastics

The Plastics Education Foundation

Robert Sherman

On behalf of the Plastics Education Foundation and myself, I want to thank your organization for allowing us to participate in your conference and convention and, specifically, to have an opportunity to speak to teachers who are the first true vocational, industrial contact the young people of our country have.

Until the students reach your classroom, they have yet to be exposed to what employment may be like in the future. What they will do in adulthood, what career direction they plan to take, in many instances is greatly influenced by the exposure in your classroom.

Today's young people become responsible at a much earlier age. They are better educated than we were at an earlier age. And the result is their desire to learn real things and not to study hobby crafts. A modern industrial arts program, if it is to satisfy today's young people, in my opinion, can no longer make just book-ends and waste baskets, but must be a true industrial experience.

Secondly, every youngster entering your class is not going to be "my son, the doctor... my son, the master... nor even my son, the bachelor." His formal education may cease at the end of his high school career. Is it fair that all of our programs for all of our young people be college preparatory programs in anticipation of continuing education? Or shouldn't education also provide opportunities to generate interest in other directions for those who do not intend to continue? I think we need to do both. And I think the industrial programs at schools need to be expanded in order to be able to do both.

What does all of this have to do with the Plastics Education Foundation, my identified subject? How is the plastics industry trying to help industrial arts teachers?

Well, first of all, why plastics at all? No industry today is faster-growing than the plastics industry. No industry today has greater opportunities for young, intelligently-trained people. No industry today can state, as the plastics industry can, that by 1985 they will be the largest single national raw material in volume. Thirty percent of the raw materials that were sold in this country in 1969 were plastics. The net growth in the industry was an 18% increase over the year before. And yet, 30% of industrial arts activity has not been plastics. I would wager that 2% to 5% might have been.

Of course there was polishing plexiglass, grinding a hunk of phenolic laminating board. But this isn't plastics or a real plastic program.

Why the Plastics Education Foundation? Simply because industry is concerned and wants to help develop manpower. The purpose of the Plastics Education Foundation is to stimulate in all ways the development of plastics programming and plastics education in schools at all levels. The Plastics Education Foundation has programs for 4-year colleges, 2-year colleges and vocational high schools in addition to its industrial arts activities. It's interested, and its scope says education in plastics at all levels of opportunity. This even includes some continuing education activities, although the majority of these are not concerned with the Plastics Education Foundation. Too many other groups do too fine a job in this area.

What is the Plastics Education Foundation doing in industrial arts and what is it preparing to do? Probably the best thing we're doing in industrial arts is illustrated at the convention hall where you can see the exhibit showing students in Ball State University and plastics industry people participating in your conference and convention, demonstrating plastic products on plastics equipment that can be used in your plastics lab. They're doing this with equipment that's been made by teachers as well as with some that's been purchased. And they're doing it with equipment and facilities that in total are not a major capital investment. You don't need $30,000 to start a plastics lab in industrial arts. The simplomatic machine that's down on the floor retails for $735 and it's a totally contained unit. I urge you to take a second look, and a hard look, at what's being done in the shop. Consider how a program of this type, recognizing your limited school budgets, could be done in your industrial shop.

Secondly, when you get back home, become acquainted with the plastics companies in your school area. I'm sure you'll find the great majority of these companies willing and able to provide you with material as well as technical assistance in your programs.

We found recently, for example, that one large molding shop threw out an average of 300 lbs. of material a month, that had been sent as samples. Three hundred lbs. of material would probably last the average industrial arts lab for the entire semester. Yet it was being thrown away. But it was asked for and it was immediately sent to a local school for their use.

Get your local plastics companies interested in what you're trying to accomplish. Believe me, they are interested, and you'll have very little difficulty in getting them involved.

Third, the Plastics Education Foundation, in cooperation with New York State, has reprinted the book, "An Experimental Resource Unit in Plastics." This is a fine volume with a tremendous course outline and curriculum program that could be of help with any industrial arts teacher for putting an activity together. So far, we've distributed 2,000 of these to teachers. It's available to any of you who would like to take the time to write me and ask for it. You must write and ask for it. Then we know who you are, too. And we can then send you additional information as we develop it.

Fourth, we're in the process of trying to develop some specific, simple guideline experiments that you can use which would be of help to you in planning your programs and activities. These are the kinds of experiments that use simple types of equipment with very little investment.

The initial outlines of these experiments are in the hands of Wayne Zook of Illinois State University, who is trying to work on updating and bringing these into line for us so that we can have them for you in the near future.

Jerry Steele, of Ball State University, has been working on another project on developing an equipment list. What type of equipment should the industrial arts shop have? What kind of cost should it be? Can it be purchased through the typical school supply catalog or must it be purchased directly from the manufacturer? In a great many cases you'll find laboratory equipment can be purchased directly from the manufacturer at a discount for education and considerably below the cost the average school catalog supply house must charge. We hope to have that for you in the next few months.

What additional areas should we be covering in industrial arts education? It's very difficult to say at this moment. We are learning just like you are. The Plastics Education Foundation is largely industry people. We're still finding our way around the school board and its education problems and recognizing the need that teachers like yourself have.

I therefore would like to invite you to participate in the Plastics Education Foundation. As you get experience, as you look through this industrial arts book, "An Experimental Resource Unit in Plastics", as you start to put equipment together in your laboratory... tell us about it. Tell us when you have found a successful way to solve a problem simply so we can pass it on to other teachers, and they can use it as part of their program, too.

If you build a new piece of equipment for yourself, like a simple vacuum molding machine, tell us about it so that other teachers can build from the same experience. We want to help you and need all the help we can get.

Welcome to the Age of Plastics!

Mr. Sherman is Chairman of the Board, The Plastics Education Foundation, Society of the Plastics Industry.

Plastics in industrial arts—teaching now about a material of the future

Harlan L. Scherer

Perhaps one of the biggest challenges facing a student about to undertake a study of the plastics industry is the language. To many, virtually a whole new vocabulary has to be understood and related to previous experiences. For example, I assume most of you here are teaching plastics courses or have an interest in the field, and even you and I may have difficulty with some of the terms that have to be understood to have a good comprehensive knowledge of the plastics industry's processes and materials.

Terms such as monomer, syntac foams, reciprocating screw, durometer, polymerization, ring tower, emulsion, oriented sheet, Engel process and ultrasonic assembly occur frequently in the professional journals of the industry and in the various technical reports and books about plastics.

If your students cannot relate to the processes and terms that are common in the plastics industry, they are going to have a difficult time understanding them.

This brings us to the basic industrial processes that should be a part of your plastics program--for by actually doing some of these processes or observing them being done by others, the student will have the opportunity to develop an understanding of the terminology and concepts of the plastics industry.

Basic to the plastics industry are processes such as: casting, injection molding, compression molding, thermoforming, extrusion, reinforced plastics, bonding, thermofusion, foam molding, coating, finishing and decorating.

An understanding and comprehension of these processes can be taught by the use of "hands on" experiences with the materials and equipment now available from various manufacturers and supplemented by the various multimedia instructional materials currently available.

When one looks at the poundage of plastics materials used by industry and compares them, as Runnalls did, with materials used in our shops when teaching about plastics, you find quite a contrast. Most professional trade journals of the plastics industry that are published around the first of the year are a good source for the industrial picture in terms of the type, amount and application of plastic materials used. Teachers concerned with presenting the plastic industry should make every effort to process these materials in their programs.

Magner, in his book, DEVELOPING ATTITUDE TOWARD LEARNING,(1) has what I believe is an excellent premise that you can apply when teaching about plastics, namely, "If I do little else, I want to send my students away with at least as much interest in the subjects I teach as they had when they arrived."

I hope most of us will carry this one step further, and try to develop a positive attitude toward the subject we are teaching. To instill this positive attitude towards plastics, I like to use an approach I shall call, "Motivation by Innovation".

Here is an adaptation of a powder molding process (Heisler process) that took place in the classroom as we were experimenting with methods of molding plastic powder. Carrying this process further we actually produced a product. Another example of a plastic molding process is the various shapes that can be formed when molding flexible urethane foam.

Another fascinating area with which the plastics industry is now working is the adaptation of plastics for the furniture industry. You can create a great deal of interest and enthusiasm in this area by using wood grain molds and casting with WEP polyesters or using polyester with wood flour and glass micro-balloon fillers to produce a synthetic wood.

How about techniqes for producing three-dimensional molds with the hot dipping plastisols? We have used this process in a mass production class to enable rapid and volume production of a chess set.

What I have talked about are but a few of the possibilities for creating that spark of enthusiasm, that desire to learn, in your classroom. I hope that some of these ideas may prove of value to your plastics program now and in the future, and help your students better to understand the plastics industry.

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(1) Magner, Robert F. Developing Attitude Toward Learning, Fearon Publishers, Palo Alto, Calif. 1968, p. 10.

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Research procedures

Rollin Williams III

In order to get our notions into proper perspective about independent study, research and development, and problem solving, there are some feelings I have about education. First, the greater our accuracy in perceiving current education problems, the greater our problems will appear. Second, the strength of our society will depend upon our educational system by reflecting and criticizing, and by stabilizing its values and concepts through this process, we face great opportunity and, frankly, we face great dangers. But, this is an important aspect of education, since it is a duty of public education to develop responsible citizens for participation in society.

In order to develop adequate perceptions about our industrial society, a student must have a knowledge of the industrial arts. Industrial arts has several objectives that are unique compared to other subjects in the school curriculum. One is to develop insights and understandings of industry and technology in our culture. Another is to discover and extend interests and capabilities of students in technical and industrial fields. The third is to strengthen the ability to use tools, materials and processes to solve technical problems involving the applications of science, mathematics and mechanics. Of course, another way of saying this might be "to develop problem-solving abilities"--to develop the ability in a student to solve problems using tools, materials, products of industry. When we discuss industrial arts, it must be stated that real and full meaning in instruction comes through first-hand contacts and experiences. When we discuss research and development, we acknowledge creative problem-solving as a method of instruction in industrial arts; but by using this method, a student can develop an understanding of more than subject matter because the method within itself contains many important understandings with which the students should be familiar. Therefore, industrial arts activities are logical procedures to develop problem-solving ability, individual instruction and research and development techniques.

We in industrial arts are concerned with research and development, as we are with other methods of instruction, not only the industrial definition, which Crawford H. Greenwalt, Chairman of the Board of Dupont, defines as, "Research is a continuing philosophy conceived in recognition of the basic truth that the future depends upon a successful search for new and better ways. So far as the physical sciences are concerned, research is directed ultimately toward creating material things for the greater convenience, comfort and well-being of people. This type of research is the essential goal of basic knowledge continuously expanding our reservoir of scientific information." While we in the industrial arts laboratory may not have the facilities or the ability to meet this definition to the fullest extent, there are many concepts in research and development procedures that must be taught in the school.

Simple research procedures can be taught effectively in the classroom. According to Boyd McCandless, no person can really debate the aims of scientific research. They include learning to ask logical questions, deciding what questions can and cannot be answered by tangible evidence, developing orderly, logical approaches to answering questions, mastering techniques to fit these approaches, evaluating the evidence gathered, communicating conclusions to others, experiencing the excitement of seeing an ordered process through to a predicted end, learning to be consistent and careful in research procedures and relating one's findings to others. If one stands back and looks at those statements, he must feel that any course that does this makes a major contribution to the educational process of a student.

Many educators feel that the present elementary and high school curriculum contains too many subjects, and it would be difficult to develop adequate problem-solving activities. There are several responses to this question. First of all, research and development procedures can and should be included in all present subject matter courses. We in industrial arts are most fortunate that our area is particularly well-suited to research and development activities. As a matter of fact, many present educators state as did Dr. John W. Nason, president of Carleton College, writing in American Higher Education in 1980, that "we teach them too much, lay too much emphasis on courses and credits and examinations. We too often regard education as the acquisition of knowledge and too seldom as imparting an attitude of inquiry, which, if properly stimulated at the right level for particular students, will lead to self-education if we provide the right environment for it."

It must be added that in order to develop this attitude of inquiry it will take a teacher to act as an experienced guide. Students will find it difficult to acquire problem-solving ability without some assistance from a teacher. The teachers of industrial arts should have unusual ability to transform knowledge to practical applications. The industrial arts teacher must be more than a transmitter of knowledge in his instruction of problem solving. Paul Torrance of the University of Georgia has developed a list of professional skills independent study requires. They include these following statements:

(1) The teacher must recognize and acknowledge potentialities. The teacher must understand the learner's potential. He must have a good concept of the student's ability.

(2) Respect students' questions and ideas. The instructor must realize that the questions of students are the main door for achieving independent study. Teachers must not ignore questions or respond to them in a superficial manner.

(3) Ask provocative questions. It has been found the vast majority of questions asked in classrooms are simply the regurgitation of textbook material. This should stop!

(4) Originality. The teacher must recognize the value of original ideas.

(5) Develop the ability to elaborate. Ideas must be developed and extended. A student has to develop ability in this area.

(6) Be careful about evaluating practice and experimentation. Many times students are reluctant to seek information using new methods because they are concerned about errors they may make and the evaluation of these errors.

(7) Develop readers with inquiry.

(8) Predict behavior adequately. The teacher needs to have the skills of observation in order to predict the behavior of his or her students.

(9) Employ planned guided experiences. Independent study and problem-solving methods must be well-guided and planned to teach problem-solving concepts adequately.

(10) Develop concepts and skills of research. To teach this adequately, a teacher must have a basic understanding of skills and concepts involved in research and development procedures.

(11) Develop skills of problem solving. Many teachers, according to Torrance, lack ability in teaching problem-solving concepts.

One might state that this all sounds fine, but how does it apply to me in my specific industrial arts class? First of all, an instructor might indicate that his students are not creative. Torrance again lists a number of indicators of creativity. He says some of them include curiosity, originality, courageous behavior, non-conforming behavior, not aware of pressure to conform, experimental in nature, will not give up, preoccupation with an idea, going beyond an assigned responsibility. Don't we all have students who occasionally fit into these categories? On the other hand, Torrance and McKinnon indicate that there are many inhibitors of creativity. Pressure to curtail imagination, punitive discipline, peer conformity, success-oriented culture, sex role emphasis, over-emphasis on the acquisition of knowledge, memorization of facts, closely-prescribed curriculum and required credit, lecture system of teaching, departmentalization-invested interests, definite division between work and play. As I look over that list, it is somewhat disturbing, because much of my education and some of my instruction can be criticized on this basis.

Well, what can we do in our industrial arts classroom to provide opportunities for creative independent study? It can be done by making assignments which call for original work, require independent learning and require experimentation and individual projects. This involves a great amount of inquiry in the laboratory, and also must involve a good deal of flexibility.

Alex Osborne describes the problem-solving process as including three major areas. They are fact finding, idea finding and solution finding. Hawkins states that the process basically includes, (1) ask the question, (2) find out all you can about the problem, (3) list the answers you think might work, (4) test the possible answers and (5) report your results.

What we must do as industrial arts teachers is to provide the opportunity for our students to solve their laboratory problems using this procedure. If you and I as teachers in industrial arts do this creatively, I suspect we will find a much wider place for industrial arts in our present educational system. It is my feeling the majority of industrial arts teachers are creative, resourceful individuals. It is my hope that they will guide their actions in trying to develop an understanding and ability in students to use problem-solving concepts.

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Communications technology

R. M. Scott

If we think of technology as a better way of doing something and extend the science to include the teaching/learning process, we have broadened our horizons. If we add the concept of communications, we have effected a product which extends and maximizes the teaching/learning resource when and where it is beneficial.

Probably the most basic resource is the human--the teacher--the expert. The challenge is to bring the right teacher and the right students together at the right time. In a sense, we are speaking of accessing, sharing or extending a resource across the boundaries of time and distance. In other instances where there are shortages of numbers or skills, we are importing a rich experience into an otherwise barren area. In many cases this is done by communications technology. Through communications, students and the teacher can visit together and interact as if they were in the same room.

To illustrate the point: In six counties of West Virginia, junior and senior high school students are receiving educational experiences never before possible. Students have widening experiences in geography, home economics, political science and cultural exchanges via communications technology. One illustrative experience was child development, taught by Dr. John Schulty, Human Relations and Child Development Specialist from West Virginia University. Students in political science have had discussions with political leaders such as the Governor and US Congressmen of West Virginia, and cultural exchange has been effected with students from Canada and Puerto Rico.

Such uses of the technology span elementary, secondary and higher education and continuing professional education. As an example of the latter, pharmacists throughout the State of Georgia are continually updated in the latest advances by the staff from the University of Georgia. It is a simple matter of the pharmacists gathering at a local institution. Programs emanate from the Athens extension center. The interaction is as if the instructor were in the same room.

There are other areas of academic pursuit where graphics, in addition to voice, play a large role. There are the situations where illustrations are a helpful and necessary part of the learning process. An illustration of voice and graphics occurs at Narragansett Bay High School in Rhode Island, where a teacher instructs two classes simultaneously--one in her presence and another a long swim away. Her second group is in a one-room schoolhouse on Block Island, off the coast of Rhode Island. The school board was unable to obtain the service of a math teacher with up-to-date qualifications, so with the cooperation of the mainland and communications technology their students are not deprived because of their remoteness. In this instance a shortage of local skills and the obstacle of distance are overcome by communications--voice and graphics.

In fact, the largest cargo plane which has ever flown, the C5A, we feel flies partially because of communications technology. Much like the Block Island illustration, engineers and professionals at the Marietta Plant have a need for aeronautical engineering instruction at the graduate level. To achieve this, a professor at Georgia Tech, in Atlanta, Georgia, teaches two aeronautical engineering classes at the same time. One is on campus and the other in Marietta, Georgia. Students in Marietta listen to the instruction, ask questions and view illustrations and notes. In this particular illustration, time and distance are elements which are bridged. Employees could not be released to drive to Atlanta.

Here in Kentucky, at Nazareth College and Catherine Spaulding College, women's colleges run by the Sisters of Charity, communications technology is utilized in teaching mathematics, science and language. The two faculties reinforce each other and, through sharing, provide strength to each institution.

These are only a few examples of the role which communications technology can play in extending and sharing resources--in these examples, "human resources"--teachers and specialists. However, not all resources are human.

In recent years the computer has become such a resource. At the university level, the computer has been utilized for normal business functions--purchasing and payrolls--for simulation and total planning, for research and as an educational tool. Likewise, at the elementary and secondary levels computer technology has been utilized as an administrative tool for such things as purchasing, payrolls, attendance and grade reporting, as a component of the curriculum and for computer assistance instruction or computer-based learning. However, not all school systems or districts can afford to have their own computer or generate all the software required to achieve full benefit of the technology. Again the role of communications technology can be seen: to share the computer or to extend its capability to otherwise barren areas. I don't intend to gloss over such concerns as control, local autonomy, individual tailoring and a multitude of other problems involved in sharing, because they are very real. However, educators are coming to grips with them and sharing through communications. For example, at the higher level of education, Dartmouth College has been innovating and has made the computer an available tool, much like the textbook and the library, to all its students. Fortunately for about 15 colleges in the New England area, Dartmouth has also made its computer and programs available to them. With limited faculty and financial resources, many schools can now offer an up-to-date curriculum. And this system is not limited exclusively to higher education--there are two high schools in the Dartmouth net. Now the educational by-product of a brilliant mathematician like Dr. John Kemeny, who is now president-elect of Dartmouth, can be shared with many institutions through communications technology. A very similar use of this can be found in Delaware, where twenty high schools share the university computer.

At the elementary and most of the secondary level of education, the computer's greatest use appears to be as teacher reinforcement as a drilling and testing device. Dr. Patrick Suppes of Stanford University has pioneered such programs, which have been widely used locally and in remote areas. In an Eastern Kentucky School District and in McComb, Mississippi, students are connected to the Suppes' computer for math drills. The students are drilled and interact with the system just as if they were in Palo Alto, California, where the computer is located.

So far, we have discussed the extension of computer technology through communications utilizing teleprinters--fast or slow. Keep in mind that other devices, such as cathode ray tubes, may be used also. And there are certain instances where audio, not print, might be the preferred medium.

New York City is a good example. For almost two years, the City Board of Education has utilized the computer and touch-tone telephones to extend the learning environment into the homes of disadvantaged students. The student, at a particular time, uses his home telephone to call the computer. The computer then asks the student arithmetical questions which the student answers by depressing buttons on the telephone. The student's teacher is provided a printout, showing the student's performance so that remedial or reinforcement-type instruction can be provided. Incidentally, if the student does not have a home telephone, he is provided one.

The extensive use has also take place in connection with voice tapes. Initially, these were restricted to the learning center, then the school premises and now the resource can be used anywhere. There is a telephone bringing educational resources to the point required when desired.

One illustrative system is working Oak Park and River Forest High Schools in Illinois, where a truly random-access audio retrieval system provides curriculum support when and as often as the students require. Usually the students access the information system from the learning center, but if they desire they can access the information from their home telephones.

A similar system also exists in the Cedar Rapids, Iowa, School District, where an information retrieval system extends to several schools in the district, so one resource can be shared among all the district schools. Plans are now under way to extend the resources to the students' homes.

In West Hartford, Connecticut, visual and sound information (TV) is extended to classrooms and learning centers in schools throughout the district for use by teacher and students on demand. As with audio tapes, video programs can be selected for individual learning or as aids to the classroom learning situation.

And doesn't this type of technological support make sense? We must keep in mind that students today are media-oriented, from grades K-8. Even by the time an average child enters the first grade today, he has watched 3,000 hours of television, utilized tape recorders, radios and seen home movies. So, even though the use of technology today is not as integrated as the textbook or the blackboard, it certainly seems to be in the cards. Isn't it just a matter of time and immeasurable effort until the practicality of the computer, learning centers, retrieval systems, etc., effect an acceptance and proliferation that are accepted as matter-of-fact teaching/learning tools?

Certainly the importance accorded today to providing opportunities for every person to achieve the highest level of education, desired or obtainable, based on his abilities, is a challenge for us all. Certainly educational technology must be a part, and, hopefully, communications can support the overall endeavor.

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for the disadvantaged

Man-technology: a viable study for the disadvantaged

Joshua Hill

Anticipating questions of considerable magnitude, for whatever reasons, to be voiced regarding the disadvantaged youth--his place in a program in the technologies--we agreed that differential attention should be accorded this topic. One favorite retort of many persons on the subject of the disadvantaged is: "I, myself, am disadvantaged." As a point of clarity, I shall use the word *disadvantaged* to identify those youths who are educationally, economically and politically disenfranchised.

The disadvantaged child is a product of societal subjugation and remission, and his deficiencies are attributable to the inequalities in our educational system and the disparities in our social strata. We can continue to perpetuate *what is* or we can work toward *what should be*. I prefer the latter; and to realize this does not require a *special* program for the disadvantaged, for this is merely a perpetuation of *what is*. But, rather, what is required is a new kind of teaching--a process in education; and along with it a new kind of commitment in education--assisting the disadvantaged child to understand technology and to cope with its phenomenal rate of change, not merely to acquiesce to it, ultimately becoming one of its cogs.

What should be is contingent upon the assumptions that:

(1) Technology is the prime force in creating change.

(2) We are fast approaching a technological society; hence, students must study technology to become adaptable to change.

(3) Industrial arts as conventionally conceived is not meeting the needs of today's youth.

(4) Homogeneity is not a characteristic of the intellectual abilities of disadvantaged youth.

(5) Youths are often labeled disadvantaged because the teacher himself is disadvantaged, since he lacks the knowledge abilities or effectiveness in relating to them (2, p.496).

(6) *Salable skills*, as often connoted, is a misnomer.

No doubt, technology and change have become freely exchanged household words, and are becoming devoid of communicable meaning. However, little action has been forthcoming to place them in proper perspective. The technology which benefits humanity and the change which transcends bigotry are undoubtedly above reproach, but the technology which dehumanizes and the change which militates against human advancement are not venerable. Develop the disadvantaged youth to know the difference. Such an approach demands that the students have learning experiences in problem-solving and decision-making, which are the tools that enable man to retain his sense of personal worth and adaptability in a technological society. I grant you this may prove to be a monumental task, and perhaps, to some, an impossible one. Then, others may feel that this is not their bailiwick. Well, I say to those who have such negative and parochial views of their jobs, cease camouflaging your true identity, for the process of education is a matter of transmitting the models through which the world is explainable. (1, p.60) Allow me to reiterate: We are fast approaching a technological society.

As revealed by the Marshall Schmitt study, "concentration of subject content in industrial arts is centered in the three areas, woodworking, drafting and metalworking." (10, p.29) The study further stated that 70 to 75 percent of class time is devoted to laboratory activities. I would venture the percentage of laboratory activities to be significantly higher in "academically-desolate areas". Allow me to impress upon you that I am not opposed to relevant laboratory activities, for technology itself is doing. However, I am vehemently opposed to inept teachers purporting to interpret the real world *via* effete media. The value of such programs in increasing student awareness and understanding of the meaningful interrelationships of subject matter and occupations and people somehow eludes me. I am usually told that the teachers are to blame, that industrial arts is still viable. Well and good, then give the disadvantaged youth industrial arts without the teachers, for there is no magic in a name.

Homogeneity is not a characteristic of the intellectual abilities of disadvantaged youths. However, we seem compelled to relegate every disadvantaged youth to a common level of academic potential and interests, when actually, the levels of abilities and interests of disadvantaged youths are as divergent as and occasionally surpass those of advantaged youths.

> So much has been written and said about the extreme want and educational situation of these children that a false image has been created. It is easy to imagine that they are somehow emotionally and intellectually inferior. These children are basically the same as all other children. Though their experience may be different, they too are interested in their world, attached to their families, and have important hopes and aspirations. If these characteristics are not visible to their teachers, it is because the teachers see only with the narrow vision of the middle class.
>
> Another false image of deprived children is that they are all alike. In truth they are as different from one another as the children of other elements of the population....
>
> If one considers affluent children, he will find differences among them as striking as those among the poor. There will be physical as well as cultural differences attributable to social origins, occupations of parents, and family income.... (12, p.13)

Students are often labeled disadvantaged, academic dropouts because the teacher himself is disadvantaged, since he lacks the knowledge, abilities or effectiveness to relate to them. Perhaps some recriminations are in order. The ability to relate to students, as used here, means that the teacher should develop a rapport which will allow him to enter into a human process--a communication process--without need for either rejection or overacceptance. The hope for the immediate future of education of this society, insofar as we have one, must rest in the teacher's capacity to communicate with his students. It means that the teacher must manage the learning environment in such a way that meaningful learning experiences are afforded the students. He must help the students to internalize these learning experiences.

> ...teachers frequently are not aware that they reject learners because of lack of knowledge, abilities or effectiveness in relating to them. Acceptance does not mean approval of the present status of being and behaving of the learner. It rather marks the base point from which the teacher tries to enter into a helping relationship. (2, p.496)

Even in view of cogent evidence attesting to the futility of salable skills, there is a relentless emphasis placed on developing more cogs for the wheel. Besides the precariousness of the phrase "salable skills", occupational programs viewed in this fashion draw heavily on disadvantaged students; thus never affording them the opportunity to transcend what is, as externally defined. I don't view this as a job for educators. Rather, we should awaken within students a desire to acquire analytical tools for whatever they consider important.

The sad part about the way the system works against the disadvantaged is that their human potentials are never developed in public schools, and very few attend college; hence, they are forced to enter the vicious cycle of training--work--unemployment--retraining. All because of a myth they were persuaded to believe about salable skills.

In conclusion, disadvantaged youths do not need special programs with promises of developing salable skills, in lieu of developing the essential indigenous human skills of analytical reasoning and problem-solving abilities. We can no longer affort to pre-empt such skills for promises of instant solutions to the wrong questions. There is a knowledge revolution in motion affecting human values, which is causing industrial arts to become an esoteric discipline serving no apparent human cause. We must join in this knowledge revolution and partake of its positive offerings.

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A simulating educational apparatus and learning combustion concepts

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Introduction and purpose. Teachers and educational equipment manufacturers have assumed for some time that instruction which includes a student-operated demonstration apparatus and completed learning exercise is more effective than a method which excludes the apparatus. This assumption seems to originate from two principle sources. First, empirical verification with equipment is the standard used to validate theoretical models in the engineering sciences. Many such devices and methods are recorded and have been adopted as standards by the National Bureau of Standards in Washington. And, secondly, active participation, involvement and maximum use of the senses are thought to create stronger impressions on the learner. Current educational research seems to substantiate this assumption, but is not conclusive. And since synthetic devices used as educational media represent a wide range of inventiveness, the merits of each are generally accepted by individual investigation. This not only implies that each device and method of instruction be evaluated individually for educational effect, but that comparisons between equipment and methods purporting to achieve similar objectives also should be made.

The purpose of the present study was to test for educational effect a method of instruction which used a student-controlled apparatus to complete combustion exercises. Educational effect was defined as measurable differences in conclusion responses between paired comparisons of control and experimental subjects on a multiple-choice test instrument. The findings of the study were inconclusive, but give further insight into (1) the development of demonstration equipment, (2) its use as a teaching vehicle and (3) experimental designs to test its effectiveness in a learning situation.

The problem. The study directed attention to two major facets of the problem. The first required construction of a combustion demonstrator that could simulate conditions within the combustion chamber of a 4-stroke cycle engine. The second focused upon the design of a learning experiment to test this apparatus for educational effect. This was accomplished by having students complete selected exercises and draw conclusions using the apparatus and by comparing their performance to students completing the same exercises *not* using the apparatus. The learning experiment was designed to answer the question: Does a student combustion apparatus which demonstrates combustion effects related to such manipulated variables as pre-combustion pressure, temperature or fuel-air mixture, have a measurable effect on the learning and retention of certain concepts correlated to these variables?

Definitions. The study defined a combustion demonstrator as a piece of equipment, operated by the student, that could verify by the use of the student's senses (i.e., sight, smell, skin sensations, etc.) the correlated effects on combustion related to pre-combustion variables manipulated by the student. That is, the student was to be able to conduct his own investigation into the phenomenon of combustion using the combustion demonstrator.

An appendage to the combustion demonstrator was the learning exercise which was defined as a sequence to order the student-conducted investigation. Using this exercise as a guide, the student was to set pre-determined variables to a defined condition before combustion, initiate combustion and observe the effects that the prescribed conditions seemed to have on the combustion process. And finally, from his observations of combustion effect, the student was to arrive at conclusions by answering pertinent questions.

Combustion was defined as a high-pressure, high-speed reaction that occurs much the same as that in a 4-stroke cycle internal combustion engine. It was to be accompanied by light, heat and possibly sound. That is, there was to be an induction of fuel and air, a compression of pre-combustion constituents, an ignition of the mixture, and an expansion and exhausting of the products. To provide additional information to the student, a four-inch vision panel was made to enclose one flat side of the combustion chamber so that the student could see and feel radiations from the moving flame front. The student could also hear vibrations from combustion sound waves within the chamber, smell and see the exhaust after-products, and have access to instruments which monitored peak combustion pressures. The static combustion demonstrator was developed by the principal investigator (Dr. Sullivan).

Hypotheses. The educational effectiveness of the combustion demonstrator to develop combustion concepts was to be tested by comparing differences in performance between subjects using the apparatus and subjects not using the apparatus. Differences were to be measured in terms of amount learned at the time of subject performance in the learning situation, and in terms of amount retained measured at a later date. The .05 level of significance was selected as appropriate for the study. The formal hypotheses were stated as follows:

Hypothesis I. There will be no difference in the amount of factual information learned about combustion by control and experimental subjects as measured by a test instrument administered to subjects of both groups immediately following the learning activity.

Hypothesis II. There will be no difference in the amount of factual information retained about combustion by control and experimental subjects as measured by an inverted form of the initial test instrument administered to all subjects at the close of the experiment.

Sampling methods. The parent population used for the experiment was composed of eleventh- and twelfth-grade male students enrolled at the Wicomico Vocational-Technical Center in Salisbury, Maryland. They may be considered purposive, in that they were chosen because of their resemblance to the larger population of vocational and technical students. Male subjects only were used because of content applicability to this group. Vocational and technical students were defined as those enrolled in approved programs as specified under the Vocational Education Act of 1963.

A sample of sixty male students were randomly assigned alternately as control or experimental subjects. This placed subjects in random pairs or blocks with each subject occupying a block. The order for participation on any given test day by paired subjects was set during this random assignment. This ordered their position as control or experimental, morning or afternoon. Randomly-paired subjects then participated in either morning or afternoon sessions of the experiment. The learning experience part of the experiment was completed in fifteen days.

Control versus experimental learning situation. By convention, control subjects participating in the experiment learned by a standard method; experimental subjects by an apparatus method. Both methods were subject-centered, the purpose being to minimize the teacher variable. A preliminary explanation was given to each subject prior to beginning each of the five learning exercises. Subjects worked alone after the explanation, proceeding at their own rate to complete these five combustion exercises. The data from each of the five exercises (given to the control group and derived by the experimental group) were explained to both control and experimental subjects. Interpretation and conclusions were left to the subject. The amount of learning was measured by the number of correct conclusion responses made on a multiple-choice test instrument.

In format, combustion exercises for both control and experimental subjects were identical. Five concept areas were identified and explored: I. Fundamentals of Combustion; I. The Effect of Air-Fuel Mixtures on Combustion; III. The Effects of Pressure on Combustion; IV. The Effects of Temperature on Combustion; and V. Abnormal Combustion. It is worthy to note here that consistent and repeatable data about abnormal combustion (commonly known as spark knock) were gathered by subjects using the apparatus. The effects of abnormal combustion during the last third of the flame travel can clearly be seen. The localized combustion effect was clearly visible, as was the audible noise distinctly different from that accompanying normal combustion.

The sequence for learning was similar for both methods of instruction. Subjects using the standard method of instruction were given data about combustion from which they were to draw conclusions. They were seated at a learning station with free access to photographs of the combustion apparatus and data-gathering instruments. The sequence of events of the exercise and data given about combustion were explained. After (1) reading preliminary information about combustion, and (2) reviewing the given data and results occurring from a particular set of conditions, (3) the questions following were answered.

Experimental subjects derived data about combustion by using the combustion apparatus as a learning station. Conclusions were similarly drawn from these derived data. The apparatus-centered learning method followed an order of (1) reading preliminary information about a combustion topic, (2) using the apparatus to fulfill prescribed temperatures, air-fuel mixtures and pressure conditions, (3) observing and recording the actions occurring during the reaction, and (4) answering questions which required conclusions to be drawn about the data. The recorded information included peak pressure, noise and flame color. An introduction and demonstration of the apparatus preceded the first exercise.

All subjects answered the same questions, which were designed to elicit conclusions about the data. All data, either given to control subjects or derived by experimental subjects, were compared to data gathered from master exercises performed earlier using the apparatus. Quantitative differences did not exist between data given control subjects and data derived by experimental subjects during the learning exercises.

Except for seeing combustion, hearing combustion and operating the apparatus, both learning situations were the same. The time to complete the apparatus method, however, was somewhat longer.

The design of the experiment was reduced, then, to finding if there are significant differences between the conclusion responses of subjects deriving data about combustion and subjects given data about combustion.

A total of fifty questions, ten per concept area, were answered by each subject immediately after each of the five exercises. Subjects started the next exercise after answering the questions concerning the preceding concept area.

An inverted form of the test instrument was administered one week after the last pair of subjects completed the learning exercises to obtain a measure of retention. The differences in performance caused by unequal time lapse between subject-pair immediate test and retention test situation were eliminated by statistical treatment of the data.

The test of significance. A review of experimental designs by Edwards to test the null hypotheses of no difference in amount learned or amount retained indicated that the random blocks analysis of variance technique would have the greatest chance of establishing significance in view of the within-group effects caused by (1) single-subject testing (which was required, because only one combustion apparatus was available), (2) subject interaction during the fifteen-day time interval required for the treatment, and (3) unequal time intervals between subject-pair immediate test and the retention test administered to the total group. The random blocks analysis of variance assumes a within-group difference between blocks, and, by eliminating this source of variance, a smaller error mean square can be used to test significance. The residual mean square becomes the error term in this instance.

The present design, then, made an effort to test the null hypotheses of no difference in amount learned or amount retained, using an apparatus method of instruction versus a standard method of instruction to learn combustion concepts defined under five broad concept areas. The design to test the hypotheses was chosen to eliminate statistically the data contamination effects caused by having only one control and one experimental station available for subject use at any one time.

The null hypotheses for immediate learning and retention were tested, using Control$_1$ versus Experimental$_1$ for the amount learned, and Control$_2$ versus Experimental$_2$ for the amount retained, where 1 and 2 are the immediate and retention test designations.

Control group versus experimental group, immediate test performance comparison. The raw data from immediate test scores for randomly paired control and experimental subjects (mean scores 24.47 and 24.73, respectively) were statistically analyzed and subdivided into constituents as seen in Table I. The calculated F ratio for treatments was not significant. A graphical representation of the data gives further insight into the paired subject comparisons. It is seen that even though experimental subjects made higher scores more frequently than not, the differences in paired scores are too variable and inconsistent to be in any way conclusive. The null hypothesis of no difference in amount learned was therefore accepted.

TABLE I

SUMMARY OF THE RANDOM BLOCKS ANALYSIS OF VARIANCE
OF IMMEDIATE TEST PERFORMANCE FOR CONTROL
VERSUS EXPERIMENTAL SUBJECTS

Source of Variation	Sum of Squares	df	Mean Square	F
Treatments	1.06	1	1.06	.029
Blocks	1001.40	29	34.53	
Residual	1061.94	29	36.62	
Total	2064.40	59		

Control group versus experimental group, retention test performance comparison. The raw data from retention test scores for randomly-paired control and experimental subjects (mean scores 22.53 and 24.40, respectively) were statistically analyzed and subdivided into constituent parts as seen in Table II.

TABLE II

SUMMARY OF THE RANDOM BLOCKS ANALYSIS OF VARIANCE
OF POST-TEST PERFORMANCE FOR CONTROL VERSUS
EXPERIMENTAL SUBJECTS

Source of Variation	Sum of Squares	df	Mean Square	F
Treatments	52.26	1	32.26	1.72
Blocks	1465.93	29	50.55	
Residual	880.74	29	30.37	
Total	2398.93	59		

The calculated F ratio was again not significant. A graphical representation of the data (Figure D-2) gives further insight into the paired subject comparison. A larger difference exists between control and experimental subjects for retention test performance than for initial test performance, but the difference is not significant at the .05 confidence level. The null hypothesis of no difference in amount of learning retained was also accepted.

Further analysis of the data. While not included as part of the original hypotheses, further treatment of the data was suggested from observation, namely, using the null hypothesis, testing the significance of the linear component between trials, and testing the significance of the difference between correlation coefficients through trials.

The lack of significance between control and experimental subjects for initial test and retention test performance required that the null hypotheses of no difference in the amount learned, or in the amount retained, be accepted. Testing the difference in consistency of performance was intended to investigate within-group performance.

A graphical comparison of control group performance with experimental group performance for trials indicated that experimental subjects seemed to perform more nearly alike through trials than did control subjects. (Figure D-3 and D-4).

The random blocks analysis of variance for trials (Table III and Table IV) yielded values of 4.08 for control subjects and .37 for experimental subjects. Both linear components tested insignificant at the .05 confidence level, using the null hypotheses (4.18 required for significance).

TABLE III

SUMMARY OF THE RANDOM BLOCKS ANALYSIS OF VARIANCE
OF THE LINEAR COMPONENT THROUGH TRIALS
FOR CONTROL SUBJECT PERFORMANCE

Source of Variation	Sum of Squares	df	Mean Square	F
Trials	56.06	1	56.06	4.08
Blocks	1355.00	29	46.72	
Residual	397.94	29	13.72	
Total	1809.00	59		

TABLE IV

SUMMARY OF THE RANDOM BLOCKS ANALYSIS OF VARIANCE
OF THE LINEAR COMPONENT THROUGH TRIALS
FOR EXPERIMENTAL SUBJECT PERFORMANCE

Source of Variation	Sum of Squares	df	Mean Square	F
Trials	1.66	1	1.66	.37
Blocks	2528.73	29	87.20	
Residual	128.34	29	4.43	
Total	2658.73	59		

Calculation of the coefficient of correlation for through-trials performance yielded a value of .54 for control subjects and .91 for experimental subjects. Testing the significance of the difference between correlation coefficients, using the null hypothesis of no difference, yielded a value of 3.30, highly significant at the .05 level.

Additional clarification is given the comparison of these correlation coefficients by calculation of their probable ranges. The correlation $r_1 = .54$ represents a ninety-five percent probability of being between .22 and .75. The correlation coefficient $r_2 = .91$ represents a ninety-five percent probability of being between .81 and .95. It is seen that in addition to their both being not zero and positive, the ranges do not overlap.

Rejection of the hull hypothesis of no difference in correlation coefficients led to acceptance of the alternate proposition--that is, that experimental subject through-trials performance correlated higher than did control subject performance.

And with acceptance of the null hypotheses of no difference in immediate test and retention test performance between randomly-paired control and experimental subjects, rejection of the null hypothesis of no difference in through-trials correlation implies that experimental subjects do perform with increased consistency through trials over control subjects. This reduces to the conclusion that while the difference in control and experimental subject performance was not significant, the difference in consistency of performance was significant and in favor of the experimental subject.

There was some question as to whether verbal ability of either the control or experimental group had an effect on performance. That is, could the difference in through-trials performance between the two groups be attributed to meaning being added to the verbal symbols of the test instrument? Or, did subjects learn and were not able to verbalize? These questions apply particularly to the control group, whose performance was the most variable through trials, and, in fact, made the numerically-significant difference in the comparison of correlation coefficients. Table V summarizes the comparison of verbal ability scores taken from the General Aptitude Test Battery (which has a mean of 100 and a standard deviation of 20 for all scores), using the random blocks analysis of variance. The means for control and experimental subjects are 91.93 and 92.97, respectively. The F ratio of .12 is highly insignificant.

TABLE V

SUMMARY OF THE RANDOM BLOCKS ANALYSIS OF VARIANCE
OF VERBAL SCORES FOR CONTROL VERSUS
EXPERIMENTAL SUBJECTS

Source of Variation	Sum of Squares	df	Mean Square	F
Groups	16.01	1	16.01	.12
Blocks	3460.35	29	119.32	
Residual	3947.49	29	136.12	
Total	7423.85	59		

It is suggested from this that in addition to a high degree of similarity between randomly-paired subjects on verbal performance, the interaction effect, if any, between blocks and treatments (time with method) for the retention test, caused by verbal ability differences, is slight. It seems more likely that the difference in retention is attributable to a stronger impression being made on the experimental subject by the apparatus method of learning.

Results and implications of the learning experiment. Concluding, the evidence to support an apparatus-student-centered method of learning combustion concepts is inconclusive as measured by the difference in amount learned and amount retained.

While the difference in learning and retention between control and experimental subjects was not significant, the consistency of performance through trials was significantly in favor of the experimental group. This implies an improved performance of experimental subjects over control subjects through trials. It cannot, however, be used to predict performance of subsequent subjects in similar learning situations without replication of the experiment using predicting rather than the present "data snooping" hypotheses regarding suspected outcomes.

Verbal ability differences between the control and experimental group seemed to play no significant part either as a separate effect or as a combined interaction effect (verbal ability with method).

A summary of the present investigation seems to indicate that an apparatus-student-centered teaching method has positive value as an educational instrument for the purpose of learning combustion concepts, although the isolated extent of this contributing apparatus parameter cannot presently be quantitatively described. The consistency of performance through trials, significantly in favor of the experimental subject, suggests a stronger and more lasting impression being made by the apparatus method. Effectiveness seems most dependent on the quality of demonstration by the apparatus, student background, student interest and the structure of the learning situation. Replication of the experiment at various levels of instruction, with various groups and apparatus types and using a greater number of defined affecting parameters, is recommended to describe and clarify further the extent of apparatus value as measured by effect on learning.

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Dr. Sullivan is presently teaching power-related courses at Southern Illinois University, Carbondale, and is conducting research into the development and testing of learning-related apparatus systems in this field.

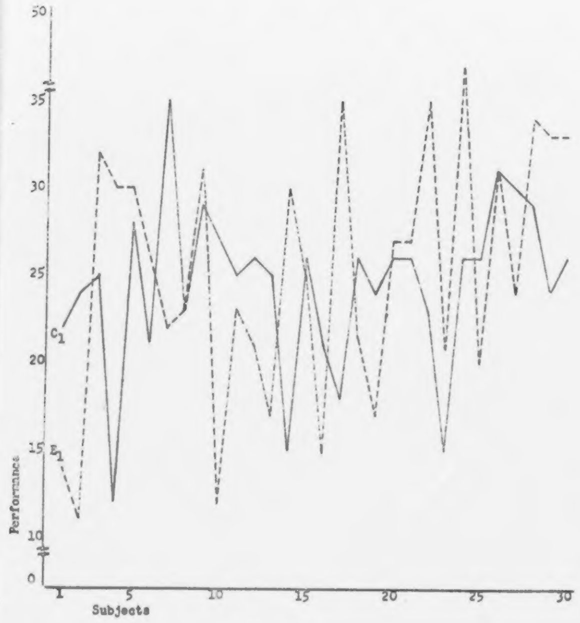

FIGURE D - 1

IMMEDIATE TEST PERFORMANCE FOR CONTROL
AND EXPERIMENTAL SUBJECTS

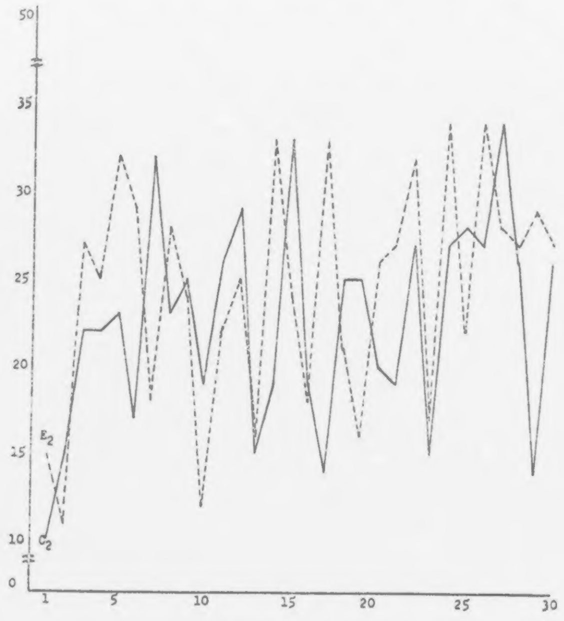

FIGURE D - 2

POSTTEST PERFORMANCE FOR CONTROL
AND EXPERIMENTAL SUBJECTS

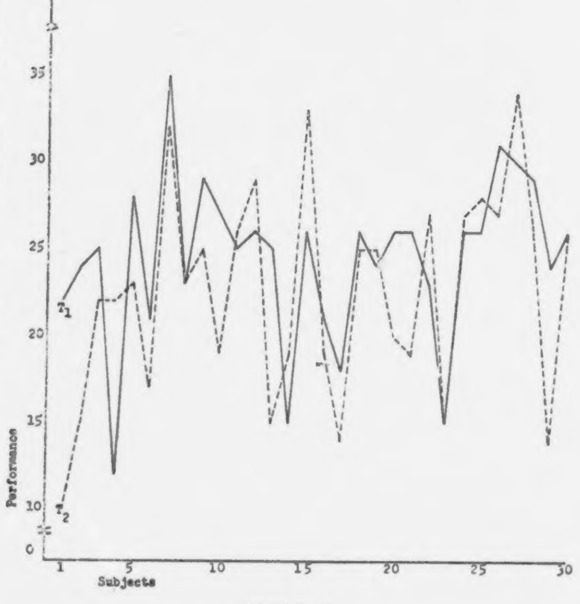

FIGURE D - 3

CONTROL SUBJECT PERFORMANCE
THROUGH TRIALS

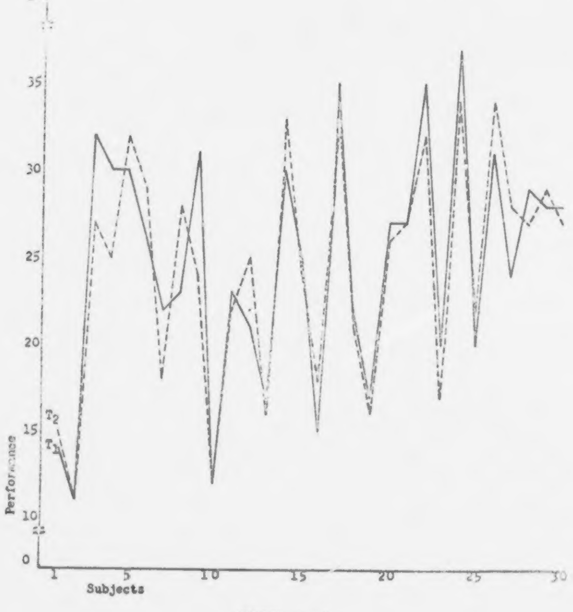

FIGURE D - 4

EXPERIMENTAL SUBJECT PERFORMANCE
THROUGH TRIALS

space technology

Technological experiments in rocket propulsion

Walter C. Krueger

There is a great deal of talk about technology. So we must ask ourselves, "What are the important technologies?" There are many important ones--power technology, metal technology, wood technology, etc. What about space technology? There is a great deal of hardware in the aerospace industry. Much of it is too large or too expensive to use in the classroom. As educators we must teach about this technology which has benefited mankind so much and finally put man on the moon.

When we talk about exploring space and other planets, rocketry is what we usually associate with it. However, rocketry is used for many other things besides space exploration.

The Chinese used rockets for weapons as early as 1232; these were basically solid fuel rockets. In the War of 1812, the British used rockets during the siege of Fort McHenry. Francis Scott Key immortalized these weapons in our national anthem ("the rockets' red glare...").

In 1926 Robert Goddard was experimenting with liquid fuel rocketry. World War II saw a great revival of rocket use. Much of the experimenting which took place then has affected us today. Some of the developments were boosters for assist takeoff use, the bazooka for the infantry, rocket launchers for prelanding bombardment. The Armed Services have developed many rocket-powered vehicles for defense and research.

I will discuss solid fuel first because it is less complex in theory and operation. A solid fuel propellant is a mixture of fuels and oxidizers formed in a mold and inserted into a combustion chamber area. These devices require an outside source to ignite them. Solid propellants are broken into two classifications:

Restricted Burning-- which is used for moderate or low-thrust duration

Unrestricted Burning -- which is used for high-thrust, short-duration applications.

The advantages of solid fuels include long storage time without deterioration, ease in handling, less complexity than liquid fuel. Some disadvantages include possible cracking of the fuel charge (causing erratic thrust levels), and inability to be shut down once ignited.

Liquid fuel rockets use a liquid hydrocarbon fuel and a liquid oxidizer (liquid oxygen, nitric acid, hydrogen peroxide). Each fuel and liquid oxidizer must have separate storage tanks so there is no mixing before they are combined in the combustion chamber. The fuels may be hypergolic or non-hypergolic, depending on the need. Liquid fuel systems have the disadvantage of being more complex and exacting in the manufacturing processes. The liquids require special handling and constant checking. Included among the advantages are a high thrust-to-weight ratio, the ability to be started and stopped at will, and the ability, in some, to be throttled to varying thrust levels.

Some typical applications of solid fuel rocketry are: pyrotechnic displays, distress signals, line-throwing rescue at sea, research vehicles, bazooka, model rocketry guided missile defense systems. Some uses of liquid fuel rocketry are: guided missile defense systems, space exploration and research vehicles.

In the Greece Central School System, we wanted a true power technology program. We decided to organize the program around more than small and large internal combustion engines. We took those fields and added rocketry, future power sources, electrical convertors, research and experimentation. This course is offered on a 9-through-12 elective basis. We had a definite need in our program, so that it was not a problem justifying the expenditure, which is minimal. There are three major companies which can supply you with the software and hardware necessary: Centuri Engineering, Estes Industries and Vashion Industries. Much of the software can be made yourself, such as slides and handouts. Some of the typical items you might need are: a static test stand, with a supply of engines; and a launching system, with supplies.

Mr. Krueger is on the faculty of Greece Arcadia High School, Rochester, NY.

business of the association

Minutes of the Delegate Assembly business meeting

April 9, 1970
Louisville, Kentucky

Edward Kabakjian

President George H. Ditlow called the meeting to order at 1:30 p.m., and instructed the seating of the delegates. Dr. Ditlow appointed Dr. Ralph Bohn as parliamentarian during the Business Meeting.

Dr. Ditlow called for the reading of the minutes of the 1969 Delegate Assembly. Dr. Edward Kabakjian, Executive Secretary, read the minutes. Mr. William Wilkinson moved that the minutes be approved as read. Mr. Robert Hostetter seconded the motion, and the motion carried.

Dr. Ditlow called for the reading of the treasurer's report. Dr. Edward Kabakjian read the treasurer's report. Dr. Robert Thrower moved that the treasurer's report be approved. Mr. Paul Kube seconded the motion, and the motion carried.

Dr. Ditlow called for unfinished business from last year's meeting. No old business was brought to the floor.

Dr. Ditlow presented the President's report. He indicated that the theme for the Association for the year would be "Curriculum Development, Recruitment and Leadership Qualities." He reported on the activities of the various committees, the National Office and the National Forum on Industrial Arts.

Dr. Ditlow asked Dr. Irvin Shutsy to give a report on convention attendance statistics. Dr. Shutsy indicated that the convention had registered 2,356 attendees at that time.

Dr. Ditlow asked Dr. Edward Kabakjian to introduce the National Office staff. Dr. Kabakjian introduced the staff and also presented Mr. Charles Ross, the Business Manager, to the membership.

Dr. Ditlow presented the Executive Board motion to the Delegate Assembly on the installation of officers. The constitutional change was read: "Bylaws, Article III, Section 8. All elective officers shall assume the duties of office at the close of the Convention." Mr. William Wilkinson moved for acceptance of the aforementioned constitutional revision. Mr. Gilbert Brooks seconded the motion, and the motion carried.

Dr. Ditlow called on Dr. Delmar Olson, chairman of the Resolutions Committee, to read the resolutions. Dr. Olson read resolutions 1 through 7 to be treated as a block and moved that same be accepted. Mr. M. D. Williamson seconded the motion, and the motion carried. Dr. Olson introduced resolution 8. Mr. James Grossnicklaus moved the acceptance of the resolution. Mr. Herbert Bell seconded the motion. Dr. Rutherford Lockette moved to table the resolution. Dr. Lee Smalley seconded the tabling motion. Dr. Olson asked for a vote from the official Delegates. The motion to table resolution 8 was overruled. Dr. Lee Smalley suggested that in the future resolutions be printed in order for the Delegate Assembly to review them, and asked for resolution 8 to be reread. Dr. Olson recognized Mr. Jack Young who indicated to Dr. Smalley and the Delegate Assembly that he would bring this matter before the Board at the next Executive Board meeting. Dr. Ditlow called on Dr. Olson to reread the resolution. Dr. Olson reread the resolution. The motion carried. Dr. Olson introduced resolution 9 which had originated with the Legislative Committee. Mr. Keeling Fife moved the acceptance of resolution 9. Mr. Neil Ballard seconded the motion, and the motion carried.

Dr. Ditlow called upon Dr. Ralph Steeb to offer information on the 1971 Convention. Dr. Steeb indicated the theme would be "Industrial Arts and Space Age Technology", and invited all in attendance to Miami on April 20-24, 1971.

Dr. Ditlow indicated to the Delegate Assembly that he had received a presentation from Mr. Don Townsend of AIASA and reported that the matter would be given prompt attention by the Executive Board.

Dr. Ditlow introduced Mr. Sherwin Powell, President-elect. Mr. Powell indicated he would continue to work on curriculum, recruitment and leadership, and also indicated the Association would be active in legislation and more personal involvement from the membership.

Dr. Ditlow recognized Dr. Robert Thrower. Dr. Thrower moved that all resolutions be printed and distributed at the First General Session or the session immediately preceding the Business Meeting. Mr. Robert Cox seconded the motion, which was carried.

Dr. Ditlow called on Dr. Edward Kabakjian for announcements. Dr. Kabakjian reported on the National Forum on Industrial Arts and indicated that the Association was interviewing for the position of Project Director. Dr. Kabakjian asked anyone interested to contact Dr. Kenneth Brown.

Dr. Ditlow reported that he had received an invitation for the members of AIAA to attend the Canadian Industrial Arts Association Convention in Andover, New Brunswick, Canada, on August 20-22, 1970.

Dr. Ditlow declared the Business Meeting adjourned at 3:45 p.m.

Teacher Recognition Committee report

Jere M. Cary

At the annual AIAA convention in Louisville, a record fifty teachers were honored as "Outstanding" among their peers, representing 43 states, the District of Columbia, five Canadian provinces and the Territory of Guam.

In his report on the Teacher Recognition Program, Jere M. Cary, AIAA Vice-president for Classroom Teachers and Chairman of the Teacher Recognition Committee, noted that the number of teachers receiving the award has risen from 21 in 1963 to the all-time high of 50 this year. This remarkable increase indicates a significant degree of support and a lot of hard work on the part of many individuals and state associations, as well as on the part of many individuals and state associations, as well as on the part of the Teacher Recognition Committee itself. This committee consists of six members, besides Mr. Cary, as follows: Jacqueline Killam, Beverly Hills, California; Russell Amling, Mankato, Minnesota; Dennis W. Harley, Saskatoon, Saskatchewan, Canada; Frank N. Kanzaki, Honolulu, Hawaii; William Wilkinson, Wallingford, Pennsylvania; and Sivert Joramo, Edmonds, Washington.

Criteria established for teachers receiving the award are as follows: The teacher who will receive the award should be selected on the bases of his demonstrated ability in the classroom teaching of industrial arts and the following suggestions are for consideration:

(a) rapport with students,
(b) ability to motivate student interest in industrial arts,
(c) success in upgrading industrial arts in the total school,
(d) ability to use ingenuity in organizing the situation at hand, and
(e) a well-grounded philosophy in industrial arts education.

The recipient must be an industrial arts classroom teacher below the college level. The recipient should be an active participant in pertinent professional educational associations on the local, state and national levels. The recipient must be a member of the AIAA at the time of his nomination.

These are basic guidelines for teacher selection. Many state associations set up additional criteria, so that the award will be the most meaningful in that state.

It is interesting to note that, this year, both of the men who hold the title AIAA Vice-president for Classroom Teachers--Jere M. Cary and Lambert K. Sailer--were elected Outstanding Teacher from their states, Washington and Pennsylvania, respectively.

Following are the Outstanding Teachers for 1970, and the associations which sponsored them:

Oluf K. Omlid, Alaska Industrial Arts Association; Gary L. Ferguson, Arizona Industrial Education Association; Charles G. Lusk, California Industrial Education Association; Richard G. Ashbaugh, Colorado Industrial Arts Association; Frank A. Lesieur, Connecticut Industrial Arts Association; Mark G. Phillips, Delaware Industrial Arts Association; James L. Winston, District of Columbia Industrial Arts Teachers Association; William McNeil, Florida Industrial Arts Association; Robert Dunsmuir Cawley, Georgia Industrial Arts Association; Ray J. Shonhardt, Idaho Industrial Education Association; Merrit Pease, Illinois Industrial Education Association; Charles M. Pearson, Indiana Industrial Education Association.

Dean W. Odekirk, Iowa Industrial Education Association; Ronald Zielke, Kansas Industrial Education Association; Robert Lee Campbell, Kentucky Industrial Education Association; Richard O. Vedrines, Louisiana Industrial Arts Association; Richard E. Grovo, Maine Association for Industrial Education; Amien G. Joseph, Maryland Industrial Arts

Association; Ralph C. Mayo, Massachusetts Industrial Education Society; Alvin C. Lydman, Michigan Industrial Education Association; Harold E. PaDelford, Minnesota Industrial Arts Association; William F. Hooper, Mississippi Industrial Arts Association; Lawrence S. Liming, Missouri Industrial Education Association; George D. Morgan, Montana Industrial Arts Association; William A. Wilson, Nebraska Industrial Education Association; Pat J. Corrado, New Jersey Industrial Arts Education Association; Orin L. Buchleiter, New Mexico Industrial Arts Association; Richard M. Vrooman, New York State Industrial Arts Association.

Marshall Murphy Carr, North Carolina Industrial Arts Association; Theodore Hillius, North Dakota Industrial Arts Association; Fred Malagio, Ohio Industrial Arts Association; Thomas M. Harris, Oklahoma Industrial Arts Association; Bernard John Lundberg, Oregon Industrial Education Association; Lambert K. Sailer, Industrial Arts Association of Pennsylvania; Edward J. Nowak, Rhode Island Vocational and Industrial Arts Education Association; Charles H. Magedanz, South Dakota Industrial Education Association; James E. Bailey, Tennessee Industrial Arts Association; Fred A. Koertge, Texas Industrial Arts Association; George R. McKay, Utah Industrial Arts Association; Rexford A. Bell, Vermont Industrial Arts Teachers Association; Robert H. Riley, Virginia Industrial Arts Association; Jere M. Cary, Washington Industrial Arts Association; Eugene C. Bailey, West Virginia Industrial Arts Association; William D. Glasspoole, Wyoming Industrial Arts Association.

Winfred B. Baker, New Brunswick Industrial Arts Association; Roger L. Matheson, Nova Scotia Industrial Arts Association; Everett L. Pirak, Ontario Industrial Arts Association; T. Grant MacGregor, Quebec Industrial Education Association; Laurence S. Pearson, Saskatchewan Industrial Education Association; Ivan Chapman, Guam Industrial Education Association.

Resolutions and expressions approved by the Delegate Assembly

Delmar W. Olson

Following are the resolutions, expressions and citations approved by the Delegate Assembly of the AIAA at the annual Business Meeting in Louisville, Kentucky, April 9, 1970. The Presentations were made at the General Sessions.

(1) Whereas George Ditlow, as president of the American Industrial Arts Association, has given so liberally of his time and his talents, exhibiting an outstanding capacity for leadership, and

Whereas the Association has made exemplary progress under his leadership,

Be it herein recorded that the Association, through its membership, officers and executive board, express its fullest appreciation to him.

(2) Appreciation to the Convention Committee, the Program Committee, and the Program and Convention Participants,

Inasmuch as the Thirty-second Annual Convention was possible only through the direct dependable and efficient service of great numbers of members of the Association, and, inasmuch as the convention has achieved a resultant outstanding level of success,

Be it herein recorded that sincerest appreciations are expressed to James H. Disney, general chairman; Joseph A. Schad, program chairman, and C. Dale Lemons, program chairman; to the members of convention committees and to all the teachers, teacher educators, supervisors and students, whose efforts in total produced this convention.

(3) Appreciation to the Ship. Inasmuch as the continuing support for and participation in the conduct of the annual convention of the Association, and, in view of the excellence of this year's commercial exhibits as a dominant feature of the convention, Be it herein recorded that the American Industrial Arts Association expresses its appreciation to Daniel Irvin, president; George Bamberger, vice-president of the Educational Exhibitors Association; to Deck Officer Don Walls and crew; and to all of the commercial exhibitors for their participation in the 1970 convention.

(4) Appreciation for the Teacher Recognition Program. Inasmuch as the Association is dedicated to encouraging excellence in teaching, and, inasmuch as its program of recognition of outstanding teachers is marked with increasing excellence, Be it herein recorded

that expressions of appreciation are tendered Jere Cary, vice-president for classroom teachers, and his committee for their contribution in the conduct and promotion of this program.

Be it also recorded that appreciation is expressed to the officers and members of state associations who have participated in this program.

Be it further recorded that the officers and members of the American Industrial Arts Association express their gratitude to the SHIP for its continued financial support of this program.

(5) Appreciation to the Public Schools. Inasmuch as the success of the 1970 convention was insured by the fullest cooperation of Dr. Newman Walker, Superintendent of Louisville Independent Schools, and his staff,

Be it herein recorded that the officers and members of the Association express their gratitude for this assistance.

(6) Appreciation to the Governor of Kentucky. In view of his support for industrial arts in Kentucky, and for the 1970 Conference of the Association in Louisville,

Be it herein recorded that the Association herein expresses its appreciation to Governor Louie B. Nunn for his assistance.

(7) Because of the vital role of the national office in the effectiveness of the service of the Association and in view of the excellence of his management and leadership in his first year as its executive secretary-treasurer, the full appreciation and confidence of the membership and the executive board is herein expressed to Edward Kabakjian.

Resolutions. Whereas, industrial arts contributes to the general education of students through interpretation of industry and its sociological and technological manifestations in grades K-12,

Whereas, industrial arts, as one of its functions, can provide occupational guidance and orientation to the world of work,

Whereas, industrial arts can satisfy the very human need for pursuit of avocational and recreational interests,

Be it resolved that the AIAA pursue a policy of educating the citizenry of our nation and particularly those whose prerogative it is to fund educational programs about the contributions of industrial arts, and to seek legislation in its support.

--AIAA Legislative Committee

Resolution. Whereas, industrial arts is designed to meet the complex and diversified needs of the students in the American school from elementary through secondary levels, and has demonstrated its ability to meet this commitment in the context of general education, and

Whereas, the US Office of Education and other Federal agencies are fostering a dualistic approach to the education of our nation's youth, and

Whereas, results of recent studies and evaluations show that many of these legislative programs are not meeting the intent of the US Congress and are not fulfilling the requirements of the students in the schools of our nation,

Therefore be it resolved, that industrial arts teachers, supervisors and teacher educators of the AIAA oppose the support of this dualistic approach to education, and

Be it further resolved, that the AIAA support the development of a single program directed toward the relevant problems of students in today's society, and

Be it further resolved, that the US Congress provide equitable funding for all subject matter fields involved in this single approach to the general education of all of the nation's youth.

--AIAA Past Presidents' Committee and Resolutions Committee

Recognition of William Everett Warner (by Delmar W. Olson) "It is my distinct pleasure on behalf of the executive board and the membership of the American Industrial Arts Association to make public recognition of one of our colleagues who has achieved significant eminence within our profession.

"Among the wealth of his innumerable demonstrations of leadership in and contributions to industrial arts on the local, national and international levels has been that of an early sensing of the need for a national professional organization for the development and promotion of industrial arts. This foresight culminated in the organization of the American Industrial Arts Association at the occasion of a national conference on Industrial Arts Teacher Education held in conjunction with a conference of the American Association of School Administrators in Cleveland, Ohio, February 27-28, 1939.

"The man of whom I speak was the first president of the American Industrial Arts Association. He saw it through its formation days, revived it after World War II, effected its affiliation with the National Education Association, and has since been its staunchest champion.

"In recognition of this service to the profession of industrial arts education and thus to the whole of American education, may I call William Everett Warner to the center of this assembly.

(Olson reads citation on plaque)

"We hope that Dr. Warner will permit the Association to permanently display this symbol of esteem on the wall of its office in Washington that all who enter may see it.

"It is also my pleasure at this time to present Dr. Kenneth W. Brown, former student and long-time friend of Dr. Brown, who will further recognize our first president."

"Dr. Warner, you, among all people, would know that through the years and through its struggles to be increasingly greater service to the human cause, the American Industrial Arts Association has remained true to the ideal which brought it into being. The result is that as an organization it never has been without that deep and abiding concern for the individual. You endowed it bountifully at the very beginning.

"It is, therefore, with humility and gratitude we speak our pride in being forever in your indebtedness. Being so, we ask, if we may, that you please accept from the members of the AIAA this particular item (a watch) as an expression in some measure of our appreciation for your life-long leadership to the profession. We believe the item, in its fineness, symbolizes the high standards of excellence you held before us constantly. With it go our best wishes." --Kenneth W. Brown

The President's Report, 1969-1970

George H. Ditlow

The American Industrial Arts Association entered the seventies with a record level of growth which was measured in membership, leadership and services to the profession. Our Association continues to be held in high esteem by the United States Office of Education, The National Education Association, Consortium of Professional Associations and numerous other professional groups and individuals working with and through our national office.

During this past year, several significant changes occurred which should be reported at this time.

National Office Staff. Dr. Edward Kabakjian was appointed as and assumed the responsibilities of Executive Secretary on August 1st. The office staff was retained intact, and the transition of continuing programs and policies established by Dr. Decker was implemented and finished with maximum efficiency. The Executive Board requested our new Executive Secretary to continue placing high priority on prompt and efficient service to the membership and increase the effectiveness of communications to and through the state representatives.

Approval was given by the Executive Board for employment of a full-time office manager to assist the Executive Secretary with the business affairs of the office. He will be introduced to you later in this session.

Executive Board Changes. At its August 1969 meeting the Executive Board agreed to have each president develop and project a platform or theme for the year. This was to run from convention to convention. Major attention was given to curriculum development and recruitment of qualified teachers. New committees were appointed to study and work with these problems.

Each board member was assigned major responsibility for coordinating one or more committee functions. A line flow chart has been developed as a working format and is being used for the first time.

Due to the need for better communications between the Board and the National Office, it was agreed that the regular summer meeting, usually held at the site of the next convention, would be moved to Washington, DC, and that this meeting be held in January. This change will permit the Board to become better acquainted with the operation and function of the National Office as well as effectively to acquaint them with and work on matters regarding registration, administration and policy.

A second Vice-president for classroom teachers was elected this year and will work closely with the other Vice-president previously elected on matters related to affiliations, membership, awards, high school clubs and teacher recognition programs.

To further expedite the effective administration of the Association, it is proposed that we install and change officers at the convention to coincide with all other committee work. To do this will require a change in the by-laws. Your Board feels it is desirable and would like to proceed with the change as soon as possible.

Membership. The membership of the Association voted to increase the dues this year to $15.00. With any such change, the first reaction is usually a dip in total membership but a very little change in income. The usual pattern prevailed. Recent statistics show that our total membership change compares favorably with the last change in dues. The membership renewal system has been continued with slight revision to send out dues notices or reminders prior to expiration rather than at the end of the year. This will assure full payment of dues and full services without interruption, thus providing for more efficient overall management.

A new structure has been established using state representatives on a regional basis as members of a membership committee. This will rotate throughout the country synchronized with the location of the convention. The Executive Secretary will continue to serve as chairman of the committee assisted by other board members. Close attention is being given to coordination of mailing lists between the state representatives and the National Office for soliciting membership. A full report of these activities with projections will be forthcoming after this convention.

Special Programs. In October, 1969, our Association was awarded a $4,000 grant through CONPASS to conduct phase I of a three-phase, three-year national forum on industrial arts. The goals established were to meet with national leaders representing government, business, industry, labor, education and management to identify methods, personnel and resources which could collectively work together in improving programs associated with training of teacher trainers.

Many individual meetings in Washington resulted in a two-day national forum January 28th and 29th, 1970, involving your entire Executive Board and 25 national leaders from organizations representing the above institutions in our society. The success of this national forum led to ultimate funding of phase II, which will provide for a series of regional conferences involving similar personnel from all fifty states. The first such regional conference will be held at the J. F. Kennedy Space Center in Florida during September or October of 1970. It will involve seven states, Puerto Rico and the Virgin Islands. We are presently in the process of selecting and hiring a director for this project who will work directly through the National Office. Approximately $62,000 has been approved by HEW to finance these conferences through F.Y. 1971. Additional information will be forthcoming in future publications.

Committee Activities. A new structure was developed for appointing and assigning committee personnel. This involves a four-year projection based upon committee tasks and functions. All committee personnel have been appointed from convention to convention. Tasks, functions and budgets can all be developed at the convention and approval given by the Board so that maximum efficiency can be achieved. Also committee work can be synchronized with the theme of the convention and the platform for the Association on a convention year basis.

Increased responsibility will be given the committees for assisting with convention programming so that more effective work and reporting can be achieved for the benefit of the total membership.

Since last year's convention in Las Vegas, the AIAA has been actively involved in a wide variety of professional activities. These include:

(1) Accreditation and Evaluation. This committee has been charged with responsibility for (1) developing criteria for institutional and self-evaluation and (2) identifying people to serve on evaluative teams at all levels. Further goals will be developed at this convention.

(2) College Clubs. A new constitution has been submitted to and approved by the Executive Board. Definite operational plans have been worked out for coordination between the colleges, the committee and the National Office. An active recruitment and affiliation program is under way.

(3) Conventions. A formalized structure has been established similar to other committees with a three-year rotating plan. Four divisional chairmen have been established which include registration, program, local arrangements and exhibits. Personnel on this committee will work closely with the Convention Director and will rotate geographically with each convention. Convention sites have been chosen for 1971 - Miami Beach, 1972 - Dallas, and 1973 - Atlantic City. 1974, 1975 and 1976 are all under study.

(4) Curriculum. Although this is a new committee, it is actively at work studying current and projected plans or innovations. The work of this committee will be closely coordinated with the national forum.

(5) International Relations. Four major goals were developed: (1) locating and publicizing employment opportunities, (2) closer liaison with other organizations, (3) publication of "international" articles of interest to members and (4) hosting an international reception for guests at the convention.

(6) High School Clubs. Real growth and enthusiasm is evident nationally with at least one state employing a full-time executive secretary to guide club activities. The committee is presently studying six or more action-type proposals. Employment of additional personnel in the National Office will assist coordination efforts.

(7) Legislation. Your entire Executive Board has an opportunity to be closely involved with problems confronting this committee at the national level. A new structure is being developed and additional members added to provide a national representation. Major attention will be directed toward identifying needs for and effecting specific legislative activities or programs.

(8) Public and Professional Relations. A positive action program is underway for developing materials and methods which will provide a national, regional, state and local impact. This will involve exhibits, publications, films, and other two- or three-dimensional documentary materials.

(9) Publications. This committee has cleared both the financial and professional hurdles to provide for a broad spectrum of publications materials. This will include films, books, pamphlets, brochures and other audio-visuals. Current activities involve both production of new and revision of existing materials.

(10) Recruitment. Although this committee is new this year, it has already taken positive steps toward formalizing a program which will solve both short- and long-range recruitment problems. Several pilot programs have already been initiated with Federal funding as a base.

(11) Research. Steps are under way to establish a regional pattern with six regions being advocated and a committee chairman for each. Close coordination with ERIC Centers is being maintained.

(12) Safety. Changes in organization, structure and purposes have been started by this committee. Identification and testing of safety practices, devices and techniques will become part of the program. Close industrial, labor, business, medical and governmental contact will be maintained.

(13) Teacher Recognition. This committee continues actively to involve and maintain contact with all state industrial arts organizations. A total of 50 outstanding teachers will be honored at this meeting from 43 states, 5 provinces, 1 territory and the District of Columbia.

Summary. An evolving pattern of regional activities on the part of committees may require study by the Executive Board of broadening all committee structures to provide for both national and regional participation of members.

National Office Publications - The Journal of Industrial Arts Education has continued high editorial and professional standards under the managing editorship of Linda A. Taxis. Monthly issues are being planned to start September, 1970.

"The Readout" changed its format and its name to "The Monitor", with wide acceptance by the members.

"The Scene" continues to be mailed to the high school clubs, and requests are being made for circulation to the entire membership. Advertising and financial support will be solicited to keep all of these publications on a pay-as-you-go basis.

Conclusion. The officers of the Association continue to look for additional ways to assist the growth and improvement of industrial arts education throughout the nation. They continue to receive requests from many organizations for assistance and direction regarding statistics, program innovations, and other detailed information. The strength of any organization is in the quality, interest and enthusiasm of its members. We hope you will continue to provide your enthusiastic support for the furtherance of these goals.

This report, although long, cannot begin to do justice to all of those hardworking dedicated individuals who so generously donate their time and energy. As your President this year, I have enjoyed my contacts with all of you. I am proud of you and the organization you believe in. No matter where one travels, throughout the nation, there is evidence of vibrant professional interest in the continued growth and development of industrial arts education. For this we can all be proud.

CHRONOLOGICAL INDEX
(convention session personnel)

1.10.2 ACIAS
ACIAS Executive Committee
Chairman, Ralph V. Steeb

1.10.3 ACESIA
ACESIA Executive Committee
Chairman, Eberhard Thieme

1.10.4 ACSAO
ACSAO Meeting
Chairman, Amien Joseph

1.20.1 ACIATE 96, 99
ACIATE-sponsored Program--"The Nature of Man--Implicationsfor Industrial Arts Teacher Education"
Chairman, Charles Shoemaker; Speakers, Alson I. Kaumeheiwa, Ronald L. Sorensen; Discussion Leaders, Julius Paster, Marshall Hahn, Charles Phallen, William Hanks, Richard Halls; Recorder, Fred Olsen

1.20.2 ACIAS
ACIAS Committee Meetings
Middle School, Herbert Bell; Recruitment, Herbert Siegel; Publications, Robert L. Woodward; Program Relationship, Cyril W. Johnson

1.20.3 ACESIA
ACESIA Committee Meeting
Chairman, Eberhard Thieme

1.30 AIAA
AIAA Standing Committee Meetings
Chairman, George H. Ditlow

1.40.1 ACIATE 105, 106
ACIATE-sponsored Program--"The Nature of Society--Implications for Industrial Teacher Education"
Chairman, Alvin E. Rudisill; Speakers, Joe E. Talkington, Howard S. Decker; Discussion Leaders, Jack Kirby, Emerson Nuethardt, William Kemp, Fred Olsen, Wendell Roy; Recorder, Julius Paster; Hosts, Alson I. Kaumeheiwa, Wa[illegible]del Dye

1.40.2 ACIAS 60, 62, 64, 66
ACIAS-sponsored Program--"Relevance of Industrial Arts Content"
Chairman, John Edward Bonfadini; Speakers, John Edward Bonfadini, Thomas A. Hughes, Jr., George Litman, Jr., Mark Delp; Recorder, Michael R. Morton; Hosts, R. T. Livingston, Stanley Grossman

1.40.3 ACESIA 38, 39
ACESIA-sponsored Program--"Innovations in the Florida Schools--Elementary School Industrial Arts"
Chairman, Eberhard Thieme; Speakers, Arthur J. Rosser, Alfred B. Howard, B. Stephen Johnson; Recorder, John Geil; Hosts, Ralph V. Steeb, Hugh Hinely

1.50.1 ACIATE 123
ACIATE Business Meeting
Chairman, Frederick D. Kagy; Recorder, Willis E. Ray

1.50.2 ACIAS
ACIAS Business Meeting
Chairman, Ralph V. Steeb; Recorder, Rodney E. Anderson

1.50.3 ACESIA
ACESIA Business Meeting
Chairman, Eberhard Thieme; Recorder, Carroll A. Osborn

1.60 AIAA 2
Opening General Session
Presiding, George H. Ditlow; Presentation of Colors, Male High School Color Guard, Louisville, Kentucky; Invocation, Hugh L. Oakley; Introduction of Special Guests, Newman Walker; Greetings, Wendell Butler; Introduction of Speaker, Frederick D. Kagy; Speaker, Robert D. Gates; Special Recognition, Kenneth W. Brown; Recorder, Walter Brown; Hosts, William S. Scarborough, Cyril W. Johnson, Delmar L. Larsen

2.10 AIAA 9, 12
General Session II
Presiding, George H. Ditlow; Introduction of Special Guest, John L. Ramsey; Greetings, The Honorable Frank Burke; Introduction of Speaker, Ralph V. Steeb; Speaker, Steve M. Slaby; Remarks, G. Don Townsend; Recorder, Thomas J. Brennan; Hosts, Dale Nish, Robert W. Leith, Myron Bender

2.21.1 AIAA 472
Major Group Session--"Teaching About the Human Side of Enterprise"
Chairman, Ronald W. Stadt; Co-chairman, Paul Lyons; Speaker, E. Robert Welsch; Responders, T. Gardner Boyd, Lewis W. Yoho; Recorder, C. E. Kicklighter; Hosts, Ronald L. Sorensen, Raleigh Karr

2.21.2 AIAA 418, 420, 422
Major Group Session--"Correction of the Offender: A Challenge to AIAA"
Chairman, Robert Elsea; Co-chairman, Richard B. Lyles; Speakers, Garland S. Wollard, Paul Richard Thomas, Joseph H. Pierce; Recorder, Walter E. Burdette; Hosts, Gene D. Minton, Herbert Siegel, B. D. Hayes

2.21.3 AIAA 188, 380, 382, 384, 542
Major Group Session--"Mission Possible: Teachers for the Real World"
Chairman, H. James Rokusek; Co-chairman, William Katz; Speakers, Donald P. Lauda, Joshua Hill, Julius Paster, Iver H. Johnson, Duane A. Letcher; Host, Charles A. Bunten

2.21.4 AIAA
Major Group Session--"Consumer Education and Financial Planning--Content Enrichment for Industrial Arts"
Chairman, Robert L. Woodward; Co-chairman, Robert Buxton; Speaker, Robert E. Gibson; Recorder, James R. Hastings; Hosts, William B. Landon, Walter O. Hayes

2.21.5 AIAA 308, 475
Major Group Session--"Basic Elements of Industry--Content Enrichment for Industrial Arts"
Chairman, Richard J. Vasek; Co-chairman, Norman E. Wallace; Speakers, Robert Magowan, George W. Howell; Recorder, Chris H. Groneman; Hosts, G. E. Baker, John E. Falls

2.21.6 AIAA 227, 227, 228, 230, 406
Major Group Session--"A Dialogue--Industrial Arts Teachers-Industrial Arts Administrators"
Chairman, Elmer S. Ciancone; Co-chairman, Ed Paloncy; Speakers, F. J. Cackowski, Joseph C. Heuer, George F. Von Spreckelsen, Jack Dean Ford, O. Frank Haynes; Recorder, Glenn Thatcher; Hosts, Stanley E. Brooks, John M. Shemick

2.40.1 ACIATE 109, 113
ACIATE-sponsored Program--"The Nature of Technology--Implications for Industrial Arts Teacher Education"
Chairman, Donald F. Hackett; Speakers, Rex A. Nelson, Paul W. DeVore; Dis-

cussion Leaders, Clyde W. Hall, James R. Heggen, Donald P. Lauda, Alfred F. Newton, John M. Pollock; Recorder, Charles Phallen; Hosts, Marshall Hahn, Leroy Crist

2.40.2 ACIAS 68, 72, 75
ACIAS-sponsored Program--"Discussion Panel--Design and Implementation of Statewide Programs in Industrial Arts"

Chairman, Arthur J. Dudley; Speakers, Ralph V. Steeb, Carl W. Butler, Jarvis Baillargeon; Recorder, G. Wesley Ketcham; Hosts, A. Dean Hauenstein, Stanley Grossman

2.40.3 ACESIA 40
ACESIA-sponsored Program--"Implementation of Elementary School Industrial Arts in Pennsylvania"

Chairman, Eberhard Thieme; Co-chairman, Earl R. Zimmerman; Speakers, Donald C. Hoffmann, Ermette Raffaelli; Recorder, Harold Gilbert; Host, G. T. Lilly

2.40.4 AIAA 407
AIASA-sponsored Program--"Why AIASA and How to Affiliate"

Chairman, G. Don Townsend; Co-chairman, Jim Kautz; Speakers, W. A. Mayfield, Jim Kautz, John Murphy, Jr.; Recorder, Bruce King; Hosts, Mark Emerson, Joe Richards, Andrew Gasperecz

2.40.5 AIAA
Special Preview--"1970 National Forum on Industrial Arts" (a video-taped presentation of some of the highlights of that event)

Chairman, Kenneth W. Brown; Speakers, James Bernardo, James J. Hammond; Hosts, James K. Jnson, Bill Cady

2.70.1 AIAA 190, 192, 194, 196
Special Interest Session--"Technology Transfer (R & D) for Industrial Arts"

Chairman, Ernest G. Berger; Co-chairman, Arthur W. Earl; Speakers, Ernest G. Berger, Arthur W. Earl, Carl A. York, David O. Wilkinson, Jr.; Recorder, Paul R. Meosky; Hosts, Billy W. Mayes, Gideon L. Woodruff

2.70.2 AIAA 279, 281, 283, 285
Special Interest Session--"The Computer--Its Role in Teaching Industrial Arts"

Chairman, Howard Gerrish; Co-chairman, Joe E. Talkington; Speakers, Alvin W. Spencer, Wayne N. Lockwood, Dale Bringman, James Babcock; Recorder, Daniel Householder; Hosts, Richard Callan, Elmer S. Ciancone

2.70.3 AIAA 127, 136
Special Interest Session--"implementing Flexible Modular Scheduling in Industrial Arts"

Chairman, Ernest L. Minelli; Co-chairman, Jerry Streichler; Speaker, Harold S. Resnick; Reaction Panelists, Leslie H. Cochran, Kenneth R. McLea, Earl S. Mills; Recorder, Paul Waldrop; Hosts, G. J. Giesler, Gerald S. Brenholtz

2.70.4 AIAA 309, 314, 317, 317
Special Interest Session--"Industrial Arts Interprets Manufacturing"

Chairman, Donald F. Hackett; Co-chairman, Talmage B. Young; Speakers, Conald F. Hackett, Talmage B. Young, Bob Cawley, Michael Hacker; Recorder, William J. Anderson; Hosts, Ralph J. Holtz, Thomas G. King

2.70.5 AIAA 244, 245, 248, 251
Special Interest Session--"Strengthening Mechanism in Metals"

Chairman, David W. Guerdat; Co-chairman, Robert E. Seward; Speakers, David W. Guerdat, Walter E. Johnson, Bobby L. Garner, Robert E. Seward; Recorder, Richard Birch; Hosts, Donald L. Hrabik, Robert Summers, Harlie Fulkerson

2.70.6 AIAA 441, 443
Special Interest Session--"Woods"
Chairman, Willis H. Wagner; Co-chairman, Sterling Peterson; Speakers, Lester E. Schaick, Michael Roger Lund; Recorder, Kenneth R. Campbell; Hosts, Edward Rusk, James K. Johnston

2.70.7 AIAA 509
Special Interest Session--"Visual Art for Industry"
Chairman, Jay L. Logue; Speaker, Charles W. Becker; Recorder, Gerald E. Nestel; Hosts, Alex H. Woodhouse, Clarence L. Heyel

2.70.8 AIAA 355, 355, 356, 360, 367, 370
Special Interest Session--"Understanding Federal Aid for Industrial Arts Education Programs, Problems and Proposals"
Chairman, Marshall Schmitt; Co-chairman, John H. Bruce; Speakers, Marshall Schmitt, John H. Bruce, James R. Hastings, Gerald T. Antonellis, Larry T. Ivey, Dwayne C. Gilbert; Recorder, Jerry C. McCain; Hosts, Louis J. Bazzetta, Rex A. Nelson

2.70.9 AIAA 198, 200, 321, 325, 386
Special Interest Session--"Bringing Technology into Industrial Arts: Innovative Programs"
Chairman, E. Allen Bame; Co-chairman, Duane A. Jackman; Speakers, Duane A. Jackman, John R. Boronkay, Donald P. Lauda, Robert E. Ryan, E. Allen Bame, Ben D. Lutz; Recorder, Preston E. Stewart; Host, Stephen Leszuk

2.70.10 AIAA 137, 141, 142, 534
Special Interest Session--"So What's New in Teaching Methods?"
Chairman, Alvin E. Rudisill; Co-chairman, Rollin Williams III; Speakers, Lawrence S. Wright, Jarvis Baillargeon, Rollin Williams III, W. Lloyd Gheen; Recorder, Curtis O. Oliphant; Hosts, James E. Good, Rayford L. Harris

2.70.11 AIAA 453, 458, 459
Special Interest Session--"Industrial Arts for Cultural Differences"
Chairman, Delmar W. Olson; Co-chairman, Marshall Hahn; Speakers, Allan P. Keeny, Herman Cecil Wilson, Gene Holton Anthony; Recorder, Claude Bell; Hosts, John Geil, Walter L. Griggs

2.70.12 AIAA 388, 392, 394, 398
Special Interest Session--"Significant Innovations for Industrial Arts Teacher Education for the '70's"
Chairman, Stanley E. Brooks; Co-chairman, Jack C. Brueckman, Jr.; Speakers, Stanley E. Brooks, Langdon Plumer, Jack C. Brueckman, Jr., Robert L. Serenbetz, William J. Weaver; Recorder, John J. Humbert; Hosts, John B. Tate, Richard Rumrill

2.70.13 AIAA 336, 338, 340
Special Interest Session--"Solid State Servicing Seminars"
Chairman, Frank Steckel; Co-chairman, Joe Sloop; Speakers, C. J. Borlaug, Ray J. Yeranki, Joe Sloop; Recorder, G. G. Peterson; Hosts, Wayne S. Ramp, Dean Teel

2.70.14 AIAA
Special Interest Session--"NEA*SEARCH--A Job-locating Program"
Chairman, John L. Frank; Co-chairman, Marvin Poyzer; Speaker, O. A. Payne; Recorder, Walter J. Hall; Hosts, Roland Kehrberg, William Edward Dugger, Jr.

2.71.15 AIAA 399
Special Interest Session--"Contemporary Concepts of Industry in a Teacher Education Program"
Chairman, Joseph W. Duffy; Co-chairman, Dale H. Messerschmidt; Speakers, Joseph W. Duffy, Andrew W. Baron, Dale H. Messerschmidt, Robert H. Thompson; Recorder, Neill C. Slack; Hosts, William G. Turner, Roger A. Vicroy

2.70.16 AIAA 523
Special Interest Session--"New Audio-visual Techniques, Equipment and Procedures for Teaching and Learning"

Chairman: Waldemar E. Klammer; Co-chairman, Wallace Fillingham; Speaker F. R. Brail; Recorder, Charles H. Wentz; Hosts, Fred L. McGilvrey, Alva Jared

2.70.17 AIAA
Special Interest Session--"Making Things Happen" (a film talk, featuring "What's Different" and "Setting Your Target")

Chairman, Marshall Tetterton; Co-chairman, John H. Erickson; Speaker, Lawrence A. Appley; Recorder, Philip W. Ruell; Hosts, Wirt L. McLoney, R. T. Livingston

2.70.18 AIAA 530, 531
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Chairman, Gerald L. Steele; Co-chairman, Harlan L. Scherer; Speakers, Robert Sherman, Elmer Meyer, Harlan L. Scherer; Recorder, William R. McNeill; Hosts, James P. LaRue, Harold Welsh

2.70.19 AIAA 444, 445
Special Interest Session--"New Woodworking Technology"

Chairman, William P. Spence; Co-chairman, W. R. Miller; Speakers, James P. Pastoret, Gerald D. Cheek; Recorder, Wayne H. Douglas; Hosts, Robert M. Dorak, Drewie G. Jenkins, Mark Delp

2.70.20 AIAA 433, 433, 435, 436, 437
Special Interest Session--"Standardized Tests: A New Tool for Evaluating Industrial Arts Education"

Chairman, G. Wesley Ketcham; Speakers, Hugh L. Oakley, Benjamin Shimberg, Ralph C. Bohn, Rutherford E. Lockette, Ralph V. Steeb; Recorder, Robert J. Spinti; Hosts, Robert W. Jones, Andrew Ryal

3.10 AIAA 14
General Session III

Presiding, George H. Ditlow; Recognition of newly-elected AIAA officers; Introduction of Speaker, Eberhard Thieme; Speaker, Jack R. Frymier; Recorder, Howard Gerrish; Hosts, David A. Rigsby, William J. Wilkinson, Richard Talbot

3.21.1 AIAA 145, 157, 327
Major Group Session--"New Industrial Arts for the Senior High School: A Program of Relevance in a Dynamic Age"

Chairman, Charles Beatty; Co-chairman, Lane Knox; Speakers, Donald Maley, Karl E. Gettle, W. Harley Smith; Recorder, James Bignell; Hosts, Lee Carter, James H. Cadagin

3.21.2 AIAA
Major Group Session--"You Won't Rate If You Don't Communicate"

Chairman, Jack Kirby; Co-chairman, William Burns; Speaker, Charles G. Arps; Recorder, Denton Floyd; Hosts, Bernard Dutton, Charles E. Earhart

3.21.3 AIAA 231, 289, 438, 523
Major Group Session--"Optimizing Individualized and Group Instruction"

Chairman, G. Harold Silvius; Co-chairman, Harold S. Resnick; Speakers, John W. Childs, Alvin E. Rudisill, Earl S. Mills, John P. Takis, John P. Novosad; Hosts, Richard A. Long, William E. Studyvin

e.21.4 AIAA 160, 165, 292, 546
Major Group Session--"Industrial Teaching Innovations"

Chairman, Chris H. Groneman; Co-chairman, Jerome Moss, Jr.; Speakers, Nevin R. Frantz, Jr., Jim S. Harmon, J. F. Entorf, James A. Sullivan; Recorder, Herman Collins; Hosts, W. A. Downs, Jerome Pearson

3.21.5 AIAA 478
Major Group Session--"Opportunities in a Changing Society"
Chairman, Donald E. Perry; Co-chairman, John M. Pollock; Speaker, Patrick Barbour Lyons; Recorder, E. Arthur Stunard; Hosts, Richard A. Lyons, Richard Flournoy

3.21.6 AIAA 203
Major Group Session--"Society, Human Values and Technology"
Chairman, Ralph V. Steeb; Co-chairman, Howard Nelson; Speaker, Paul W. DeVore; Recorder, Ralph Dirksen; Hosts, Ervin A. Dennis, Donald W. Cramer

3.30 AIAA
Special Preview (see listing for 2.40.5)
Hosts, Lambert K. Sailer, Alan P. Keeny

3.40 AIAA 558, 559, 560, 562
Business Meeting and Teacher Recognition Program
Presiding, George H. Ditlow; Teacher Recognition, Robert L. Sanders; Presentation of Outstanding Teachers, Jere M. Cary; Presentation of Awards, Sherwin D. Powell; Recorder, Edward Kabakjian; Hosts, Charles Lash, Stephen A. Miller

3.50.9 IACC 414
Terry Pemberton, Recorder

3.51 AIAA 340
Special Interest Committee Meeting--"A Proposal for an Electronics Education Council"
Chairman, Larry Heath; Co-chairman, Henry Wilchek; Recorder, Lorimer Bjorklund; Hosts, Donald M. Froelich, M. Duane Mongerson

3.52 ACIATE 120
Special Committee Report--"Graduate Studies Forum"
Chairman, Robert M. Tomlinson; Speaker, Lawrence S. Wright; Recorder, Charles Stewart; Hosts, Ewell W. Fowler, Dale R. Patrick

3.60.1 ACIATE
ACIATE-sponsored Program--"Man-Society-Technology--The Future. Implications for Industrial Arts Teacher Education"
Chairman, Charles Keith; Honor Host, William E. Warner; Speaker, William D. Drake; Presentation Analysts, John Michaels, Al Squibb, George Horton, Charles Bunten, Bryant Crawford; Recorder, Charles Shoemaker; Hosts, Donald P. Lauda, Charles G. Risher

3.60.2 ACIAS 78
ACIAS-sponsored Program--"Industrial Arts in Relation to Vocational Education"
Chairman, Earl R. Zimmerman; Speaker, Mr. Zimmerman; Recorder, Cyril W. Johnson; Hosts, Sol M. Silverman, Allan B. Myers

3.60.3 ACESIA 43, 48
ACESIA-sponsored Program--"Innovations in Elementary Education"
Chairman, Eberhard Thieme; Speakers, Lester J. Hamil, Jr., Jarvis Baillargeon; Recorder, Carroll A. Osborn; Hosts, Robert W. Innis, John Porter

3.61.1 AIAA 519
Special Interest Session--"New Curriculum Materials for Graphic Arts"
Chairman, Walter L. Griggs; Co-chairman, Joseph E. Haslett; Speakers, W. D. Baker, J. M. Foley, William Flack; Recorder, John Gedker; Hosts, Wendell L. Swanson, C. E. Strandberg

3.61.2 AIAA 342, 344, 345, 346
Special Interest Session--"New Approaches to Teaching Electricity/Electronics"
Chairman, William Edward Dugger, Jr.; Co-chairman, James T. Ziegler;

Speakers, Alan R. Suess, James T. Ziegler, Dale R. Patrick, William Edward Dugger, Jr.; Recorder, William R. Grieve; Hosts, G. E. Baker, Frank Steckel

3.61.3 AIAA 513
Special Interest Session--"Superpositions of the Art of Technical Illustration"
Chairman, William J. Wilkinson; Speaker, Daniel B. England; Recorder, W. R. Forkner; Hosts, Joseph E. Metcalf, E. Allen Bame

3.61.4 AIAA 410, 411, 413, 414
Special Interest Session--"Club Public Relations--School, Community, State and Nation"
Chairman, G. Don Townsend; Co-chairman, Jim Kautz; Speakers, Ronald King, Eli E. White, Tim Beron, Bruce King, Walter Comeaux; Recorder, Billy W. Mayes; Hosts, Mike Warren, Harry Slack

3.61.5 AIAA 330, 348, 555
Special Interest Session--"Teaching the Technology of Power"
Chairman, Terence Trudeau; Co-chairman, Lee Carter; Speakers, Anthony J. Palumbo, David V. Gedeon, Walter C. Krueger, Leigh Bernard Weiss; Recorder, Edward O. Morical; Hosts, Douglas LaFauci, Andrew A. Kuban

3.61.6 AIAA 256
Special Interest Session--"Materials, Processes and Product Testing"
Chairman, Louie Melo; Co-chairman, Ralph C. Bohn; Speakers, Louie Melo, Syd K. Lee; Recorder, Boyd R. Whitt; Host, Ralph E. Dyson

3.61.7 AIAA 448, 449
Special Interest Session--"Macro Identification of Wood"
Chairman, Jack Luy; Co-chairman, Albert G. Spencer; Speakers, Albert G. Spencer, Frank M. Pittman; Recorder, Jerry W. Heath; Hosts, C. Richard Lanier, Ivan E. Lee

3.61.8 AIAA 374, 375, 377
Special Interest Session--"Surplus Property Utilization Program"
Chairman, Clinton W. Kersey; Co-chairman, E. L. Palmer; Speakers, Clinton W. Kersey, E. L. Palmer, Talmage B. Young, Chester Lane; Recorder, William F. Alexander; Hosts, Charles F. Kneece, Larry T. Ivey

3.61.9 AIAA
Special Interest Session--"Industrial Arts in the Greece Central School District--Organized for Action"
Chairman, James E. Good; Co-chairman, Douglas Ladd; Speakers, James E. Good, Donald J. Jambro, John C. Duggan, Douglas Skeet; Recorder, Robert W. Jones; Hosts, Gerald D. Bailey, Stan Stammen

3.61.10 AIAA 232, 234, 236
Special Interest Session--"New Curriculum Patterns in Industrial Arts"
Chairman, Thomas A. Hughes, Jr.; Co-chairman, George Litman, Jr.; Speakers, Robert O. Beauter, Mark Delp, Michael R. Morton; Recorder, Louis Ecker; Hosts, Cecil Sanders, J. Phillip Young

3.61.11 AIAA 465, 469
Special Interest Session--"Special Education"
Chairman, Joseph J. Littrell; Co-chairman, W. E. Wright; Speakers, Roy C. Gill, Leon T. Harney; Recorder, David E. Dicux; Hosts, Norman J. Rex, Alan P. Keeny

3.61.12 AIAA 425, 427, 429
Special Interest Session--"Involving Industrial Arts in Correctional Education Programs"
Chairman, Shelvy E. Johnson; Co-chairman, Homer Howard; Speakers, L. E. Jensen, Kenneth Wayne Yancey, Charles E. Aebersold; Recorder, Homer B. Towns; Hosts, Richard D. Holzrichter, Herman C. Wilson

3.61.13 AIAA 168, 169, 171, 179
Special Interest Session--"Emerging Changes in the Teacher-Learner Process and Implications for Industrial Arts"

Chairman, Kenneth L. Schank; Co-chairman, David L. Jelden; Speakers, Kenneth L. Schank, Ernest L. Minelli, David L. Jelden, Arthur H. Schwartz; Recorder, William F. West; Hosts, Lambert K. Sailer, Kenneth R. Clay

3.61.14 AIAA 496, 501, 504
Special Interest Session--"Managing a Safe Environment in Schools"

Chairman, Everett R. Glazener; Co-chairman, Rex A. Nelson; Speakers, Ralph J. Vernon, Andrew D. Hosey, Morris J. Ruley; Recorder, Maurice C. Thomas; Hosts, Clifton Clark, Marshall Tetterton

3.61.15 AIAA 182, 183
Special Interest Session--"IACP Status Report"

Chairman, Donald G. Lux; Co-chairman, Willis E. Ray; Speakers, Donald G. Lux, Russell C. Henderly, Everett G. Sheets; Recorder, William R. Erwin; Hosts, Berkley Ruiz, John L. Frank

3.61.16 AIAA 211, 213, 219, 222
Special Interest Session--"Man and Technology"

Chairman, Robert D. Brown; Co-chairman, John R. Lindbeck; Speakers, Robert D. Brown, John R. Lindbeck, Eckhart A. Jacobsen, W. R. Miller; Recorder, Howard I. Shull; Hosts, Ronald M. Frye, Talmage B. Young

3.61.17 AIAA
Special Interest Session--"Making Things Happen" (a film talk, featuring "What's Different" and "Setting Your Target")

Chairman, Rayford Harris; Co-chairman, James L. Boone, Jr.; Speaker, Lawrence A. Appley; Recorder, J. Page Crouch; Hosts, Richard M. Coger, G. O. Mann

3.61.18 AIAA 183, 297, 301, 303, 538
Special Interest Session--"Instructional Media Symposium"

Chairman, Lyndall Lundy; Co-chairman, Harry L. Johnson; Speakers, Raymond G. Fox, Robert W. Singer, John D. Jenkins, Tom E. Lawson; Recorder, Rufus C. Johnson; Hosts, Albert Pautler, William E. Brown

4.10 AIAA 24
General Session IV--"Extensions of Technology--From Utopia to Reality"

Presiding, George H. Ditlow; Introduction of Speaker, Sherwin D. Powell; Speaker, Henryk Skolimowski; Recorder, Leo F. Hogan; Hosts, Jay A. Borden, Robert H. Hawlk

4.21.1 ACIATE
ACIATE-sponsored Program--"Man-Society-Technology--A Forum on Teacher Education"

Chairman, H. James Rokusek; Forum Participants, Julius Paster, Jack Kirby, Wendell Roy, Alfred F. Newton, George Horton, Marshall Hahn, Emerson Neuthardt, Clyde W. Hall, John M. Pollock, Bryant Crawford, Charles Phallen, William Kemp, James R. Heggen, Richard Hall, Al Squibb, William Hanks, Fred Olsen, Donald P. Lauda, John Michaels, Charles Bunten; Recorder, Alvin E. Rudisill; Hosts, Donald F. Hackett, Ronald Tucker

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ACIAS-sponsored Program--"Industrial Arts Activities Across the United States"

Chairman, Robert Gates; Speakers, Carl W. Butler, Darrell Brown, Allan B. Myers, Lynn P. Barrier, Norman L. Myers, Herbert Bell; Recorder, Robert Thomas; Hosts, Joseph Zupancic, James Reynolds

4.21.3 ACESIA 50, 51, 52, 54
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Chairman, William R. Hoots, Jr.; Speakers, Mary-Margaret Scobey, Robert G.

Thrower, Larry T. Ivey, Thomas J. Jeffrey, et al.; Recorder, Paul Kuwik; Hosts, James Hall, Donald Wendt

4.22.1 AIAA 237
Majr Group Session--"Effective Teaching--How To Do It"
Chairman, Rollin Williams III; Co-chairman, John Edward Bonfadini; Speaker, Robert M. Wilson; Recorder, William D. Wargo; Hosts, Carl E. Brown, Earl E. Smith, Mike Adams

4.22.2 AIAA 485, 488, 491
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Chairman, Paul T. Hiser; Co-chairman, James O. Reynolds; Speakers, Herman J. Peters, Eugene Woolery, Robert C. Bills; Recorder, Harvey E. Morgan, Jr.; Hosts, James Sloan, Tim Wentling, Merrill M. Detweiler

4.22.3 AIAA 261, 263, 266
Major Group Session--"Materials Technology in Industrial Arts"
Chairman, David W. Guerdat; Co-chairman, Louie Melo; Speakers, David W. Guerdat, Louie Melo, Lorin V. Waitkus; Recorder, John B. Tate; Hosts, John Winterhatter, Harold H. Bretz, Jr.

4.40.2 AIAA
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Hosts, Robert Lee Campbell, Harold PaDelford

4.41 AIAA 239, 271, 275
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Chairman, John O'Meara; Speakers, Harold W. Ruf, Wilbert C. Bohnsack, Ralph E. Betterley; Recorder, Eldon Broman; Hosts, John B. Degler, Robert A. Banzhaf, Lawrence F. H. Zane

4.50 AIAA
Annual Banquet and SHIP Program
Presiding, George H. Ditlow; Invocation, The Reverend Bill Ratliff; Introduction of Speaker, F. Jack Young; Speaker, Nancy G. Roman; Introduction of Honored Guest, Edward Kabakjian; Remarks, Louis B. Russell, Jr.; Recorder, Alfred F. Newton; Hosts, Edwin C. Hinckley, Henry S. Paulin, Robert L. Serenbetz, John Gibson. For the SHIP: Daniel Irvin, Don Walls, George Bamberger, Tom Eggers

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